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FRONT COVER

LIONESS WITH FOUR CUBS IN GIR (GUJARAT).

Photo - Rohit Vyas

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TREND OF POPULATION OF TIGER AND LEOPARD IN SIMILIPAL TIGER RESERVE : A CONSERVATION CONCERN

B.C. PRUSTY* AND L.A.K. SINGH**

Similipal Tiger Reserve, Baripada (Orissa)

Introduction

Media-based doubts have been expressed in recent years about the continued survival of Tiger in India. While causes for this are attributed to international market on Tiger products, critics have, nonetheless, released debates concerning the 'procedure of pug-mark census'.

As regards the 'pug-mark census method' there is no total substitute to it because of its wide applicability, replicability, cost effectiveness and precision. Besides, data obtained from pug-mark census also reveal the biological aspects of Tiger in the wild (Sagar and Singh, 1993; Singh, 1995).

The Tiger indeed may become extinct in the wild sooner than we think not just because of the market for Tiger products but for habitat shortage and inbreeding depression.

The present paper discusses the trend of population of Tiger in Similipal Tiger Reserve, Orissa, and the possibility of a population crash in the case of Tiger because of reduction in ecological density and possible inbreeding depression.

Methods

In Similipal Tiger Reserve pug-mark census is based on the method (Choudhury, 1971) originally championed by the founder Field Director late S.R. Choudhury and subsequent improvements by Panwar, 1979; Pattnaik and Singh, 1993; Sagar and Singh, 1990, 1991. The method estimates the population of Tiger and Leopard.

Census is carried out in the month of January. During this month the weather is dry and cool; the forest undergrowth is still very dense hence the Tiger's area of movement is limited.

The Tiger pug-marks are searched along different routes which include river banks, beds of dry streams, forest roads, footpaths and animal tracks.

There are 48 census units, 187 census routes, and 3585 numbers of PIPs scattered over a route length of 1339 km. On an average each unit has to cover two routes every day. The density of the PIPs is 2.7 numbers per km or 19 per route.

The PIPs (Pug-Impression Pads) are specially prepared ground-pads where a layer of 2-3 cm fine soil is spread and the ground is made suitable for registering pug-mark impressions. Each PIP extends along the entire width of the road and stretches upto 200 cm along the length of the road. A number of such PIPs are laid down at strategic points.

* Field Director, ** Research Officer.

Census is catried out for six days. During this period each PIP is checked at least twice in three days interval. The tracings done in a prescribed form and the plaster casts are brought for analysis. The following was the work schedule for the year 1995-census year.

Preparation started	:	November 1994
Training of staff in the field	:	23-27 Dec. 1994
Census dates	:	03-08 Jan. 1995
Completion of analysis	:	July 1995

During 1995-census year about 700 pieces of information were brought to us in the shape of plaster casts and tracings for analysis. Step by step data were compiled from tracings. Similar tracings and data from adjacent routes were compared and overlappings were discarded through meticulous and rigorous elimination processes.

After initial stages of manual work, the data were fed into a dBASE structure in a computer to generate reports. These reports are used for matching and elimination work which involve the consideration of a number of parameters including practical field knowledge.

Six students and three faculty members from M.P.C. College, Baripada and Karanjia Govt. College, Karanjia participated in the programme. For the first time NGO participation in Tiger census programme was thus ensured from 1995.

Results

The results of census during 1972 to 1995 in Similipal Tiger Reserve are presented in Tables 1 and 2. During 1993 the figures for Tiger were 24 male, 49 female and 22 cubs, and for Leopard the figures were 33 males, 54 females and 12 cubs. During 1995 the figures were, Tiger : male 25, female 47, cub 25, total 97. and Leopard : male 37 female 47 cub 16, total 100. although there has been continuous improvement in census method and analysis, the figures of the census during the last several years appear to be similar and stable.

Discussion

During the last couple of years certain

Table 1

Trend of population of Tiger in Similipal Tiger Reserve.

Year	Male	Female	Cub	Total
1972				17*
1975				30*
1976				46
1977	23	29	4	56
1979	22	39	4	65
1984	31	43	7	81
1986	32	51	6	89
1989	20	51	21	92
1990	22	51	21	94
1991	24	50	22	96
1992	24	49	22	95
1993	24	49	22	95
1995	25	47	25	97

*These figures are recognised to be incomplete because the entire area of STR wasn't covered.

Table 2

Trend of population of Leopard in Similipal Tiger Reserve.

Year	Male	Female	Cub	Total
1989	28	42	0	70
1990	34	50	12	96
1991	40	47	11	98
1992	33	54	12	99
1993	33	54	12	99
1995	37	47	16	100

academic as well as managerial issues relating to Project Tiger have been raised which deserve serious attention. Doubts have been expressed on continued survival of the Tiger. It is also alleged that doubtful procedures are adopted for "census". Unfortunately, stray instances have been used to draw general inferences about the management and census technique adopted in all Tigers reserves to the country. Sometimes such inferences, sadly, are from ombudsmen. The critics have ignored the need of keeping some good areas available for the Tiger to breed and propagate along with its prey base.

There are more than 1200 village in a 10 kms belt of the periphery of Similipal Tiger Reserve. Inside the reserve there are 65 revenue villages, out of which 4 are inside the core. Since the core area is also the proposed National Park, relocation of 4 villages is in the offing. As per the 1981 census the total population in the above villages in the core and buffer of the sanctuary was 8,643. The rate of increase of population has been 21.2% over the decennial period 1971-81. During 1991 census the human population inside the Similipal Sanctuary was 10,273 i.e., an increase by about 19%. This means, within the life of the Project Tiger the human population in Similipal Tiger Reserve has increased by about 40% (Prusty, 1996)

Data of Similipal from 1989 to 1995 indicates that the Tiger and Leopard population are more or less stable while there is a simultaneous increase in human population. Therefore, the areas where intense human activities exist, and which Tigers normally avoid, have increased. Thus it can be expected that the extent of areas occupied by a fixed number of Tigers has reduced. That is, the ecological densisty of Tiger in Similipal has decreased. If the trend continues a 'population crash must be expected as imminent'.

Population crash also can be expected to occur in an 'isolated' insularised population where there is 'inbreeding depression' (Frankel and Soule, 1981).

The 'ecodevelopment schemes' are good enough within 'textbook means' with some practical applicability to take care of the human dimensions causing pressure in the Tiger habitat. But certainly this should not be used as weapon to prevent relocation of a bare minimum number of villages from the core area. Instead of abandoning the idea of relocation or insisting on a voluntary relocation (which is a very impractical proposition in the Indian situation) the agencies funding for ecodevelopment should instead 'totally fund and carry out the relocation of villages' if the ultimate goal is to prevent a natural ecosystem turning into a 'human-system'.

SUMMARY

In Similipal Tiger Reserve pug-mark census is carried out to estimate the population of Tiger and Leopard. The procedures and work schedules have been standardised over the years. During twenty years of existence of Project Tiger the human population in Similipal Tiger Reserve has increased by about 40%. The census data on Tiger and Leopard from 1989 to 1995 indicates that their population are more or less stable. But the implications of a stable Tiger population against increasing human population in the Tiger Reserve is a clear indication that the ecological density of Tiger in Similipal has increased. If the trend continues there is risk of inbreeding depression and population crash. It is therefore, urged that 'ecodevelopment schemes' though take care of the human dimensions causing pressure in the Tiger Reserve, these should not stand bar against relocation of a bare minimum number of villages from the core area of the Tiger Reserve, if the ultimate goal is prevention of a natural ecosystem turning into a 'human-system'.

सिमलीपाल बाघ आरक्षित क्षेत्र में बाघ और तेन्दुओं की संख्या - संरक्षण का चिन्ता विषय

बी०सी० प्रुस्टी व एल०ए० के० सिंह

सारांश

सिमलीपाल बाघ आरक्षित क्षेत्र में बाघ और तेन्दुओं की संख्या का अनुमान लगाने के लिए उनके पग चिन्हों की गणना की गई। बाघ परियोजना के पिछले 20 वर्षो के दौरान सिमलीपाल बाघ आरक्षित क्षेत्र में मानव जन संख्या लगभग 40% बढ़ी है। परन्तु बाघ आरक्षित क्षेत्र में बढ़ती जा रही मानव जन संख्या के समक्ष बाघों की संख्या स्थिर बने रहने का निहितार्थ यही है कि सिमलीपाल में बाघों के पारिस्थिकीय घनत्व में कमी आई है। यदि ढ़र्रा ऐसा ही चलता रहा तो इनके अन्तप्रजनन में मन्दता आने और जनसँख्या के टूट जाने तक का खतरा है। इसलिए इस बात पर जोर दिया गया है कि यदि हमारा अन्तिम लक्ष्य एक प्राकृतिक परिस्थिति-संहति को मानव प्रणाली में बदल जाने से बचाना है तो बाघ आरक्षित क्षेत्र के आन्तरिक खण्ड से कुछ न्यूनतम गांवों को हटाकर उन्हें अन्यत्र बसाने में कोई बाध्य खडी नहीं की जानी चाहिए।

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PREDATION PATTERN OF THE ASIATIC LION ON DOMESTIC LIVESTOCK

H.S. SINGH* AND R.D. KAMBOJ **

Introduction

The Lion is a migrant into India from West Asia through Persia and the North-Western passes. It spread South-eastward from its original home in Central Europe and entered into North-West Asia where it ultimately diverged towards Africa and South-West Asia. Records and evidences regarding the distribution of this great cat in Northern and Western India and its total absence in the South of the Narmada River further indicate that India was not its original home. Historically the Lion has been predating on domestic livestock since ages as livestock rearing was the main occupation of the people in the regions where Lion entered and roamed in India. Development of civilization with widespread practice of pastoralism in the subtropical zone overlaps the home range of the Lion. Unlike the Tiger which lives in dense forests, the Lion prefers an open habitat preferably savannah forests which have also been used traditionally as grazing grounds for livestock by the communities inhabiting these areas. This overlapping of Lion's home range with traditional grasslands itself indicates that the Lions must have been hunting the domestic livestock since ages.

Although the Lion tolerated and respected human beings yet man failed to protect the animals as it disappeared from everywhere in Asia outside the Kathiawar peninsula around 1840. In India too it was relentlessly slaughtered and the last animal surviving in the wild outside Saurashtra was killed in 1884. At present, Gir forest remains the last abode of the Asiatic Lion with 304 lions inhabiting the Gir Sanctuary and National Park and its peripheral forests located in Saurashtra region of Gujarat State in India (Anon., 1995).

The predation ecology of the Lion in Gir forest studied over the years (Joslin, 1973; Sinha, 1987; Chellam, 1993) indicate that predation behaviour of the Lion changed gradually from its dependency on domestic livestock to the wild herbivores. A complete reversal in the predation pattern of Lion has been witnessed in the last 25 years which has been possibly due to increased availability of wild ungulates in the protected area (PA). However, about 15% of the lions residing outside the PA still derive a major portion of their food from domestic livestock.

The analysis presented in this paper primarily focuses on the temporal and spatial variations in domestic livestock predation pattern of the Lion in the sanctuary as well as outside the sanctuary so as to understand its implications from management point of view. The analysis may be very helpful in formulating appropriate wildlife management strategies in future.

* Conservator of Forests, Gandhinagar Circle, Gandhinagar (Gujarat).
** Deputy Conservator of Forests, Gir West Division, Junagarh (Gujarat).

Materials and Methods

The domestic livestock of resident maldharis and inforest settlement farmers are permitted to graze in the sanctuary and compensation as per Govt. rules is paid in the event of killing of such livestock/human beings by the carnivores in the PA. Similarly all types of domestic livestock killed by the carnivores outside the PA are also eligible for compensation. All such incidences of domestic livestock kills are properly investigated and recorded in the prescribed proformas/registers maintained in both, i.e., Gir West and Gir East Divisions. Thus except for few kills of domestic livestock grazing unauthorisedly within the PA most of the cases of lions predation on domestic livestock are duly registered along with the date and place of kill, predator etc. The information regarding the domestic livestock killed by Lion was collected from both the divisions for the past ten years and computed in Table 1. Similarly the data about monthwise domestic livestock killed by lions were averaged and given in Table 2.

The abundance, temporal and spatial distribution and size of the prey, all influence the predation by large cats. In order to assess the impact of all these factors on domestic livestock consumption pattern of Lion, the necessary data regarding availability of wild ungulates and resident domestic livestock, which constitute the major prey base of the apex predator, were collected from the recent census results (Anon., 1995) and computed in Table 3 so as to compare the predation pattern of Lion in different parts of the PA.

Results and Discussions

Large scale predation of Lions on domestic livestock was reported between 1901 to 1904 after great famine of 1899 when majority of wild ungulates and bulk of the domestic livestock in Gir forest perished for want of water and food which in turn resulted into increased man-animal conflicts. Herbivores population picked up and herds of buffaloes in Gir forest had established in good number by 1911 which subsided menace to human life. Probably, Lion predation on livestock depended on the habitat condition and herbivores

Table 1

Number of domestic livestock killed by Carnivores

Year	Within the PA		Outside the PA		Total kills		Total kills
	Lions	Leopards	Lions	Leopards	Lions	Leopards	
85-86	260	-	839	14	1099	14	1113
86-87	473	-	657	03	1130	03	1133
87-88	340	-	389	05	729	05	734
88-89	349	-	1111	09	1460	09	1469
89-90	271	-	1343	04	1614	04	1618
90-91	445	1	1595	10	2040	11	2051
91-92	492	-	1586	14	2078	14	2092
92-93	477	-	1386	18	1863	18	1881
93-94	418	-	1195	13	1613	13	1626
94-95	512	-	1384	14	1896	14	1910
	4037	1	11485	104	15522	105	15627

Table 2

Monthwise average domestic livestock kills by the Lion

Month	Inside Sanctuary			Outside Sanctuary			Total		
	Gir (E)	(Gir (W)	Total	Gir (E)	(Gir (W)	Total	Gir (E)	(Gir (W)	Total
January	30	2	32	51	46	97	81	48	129
February	36	10	46	56	62	118	92	72	164
March	33	11	44	53	71	124	86	82	168
April	31	9	40	54	61	115	85	70	155
May	30	12	42	52	46	98	82	58	140
June	30	12	42	51	75	126	81	87	168
July	30	6	36	52	91	143	82	97	179
August	29	6	35	53	68	121	82	74	156
September	30	7	37	54	54	108	84	61	145
October	29	8	37	53	58	111	82	66	148
November	30	8	38	52	71	123	82	79	161
December	31	9	40	52	110	162	83	119	202
Total	369	100	469	633	813	1446	1002	913	1915

Note :- Above figures do not include the kills in Girnar forests.

Table 3

Comparison of livestock predation by Lion in Gir (E) and Gir (W)

	Number of lions (adult & subadult)	Domestic livestock population within PA	Wild ungulate population	Number of livestock killed by lions	Average number of livestock killed/lion
Gir(E)	83	9339	7405	998	12.0
Gir(W)	137	4714	31410	912	6.7
Total	220	14053	38815	1910	8.6

population density (Rashid and David, 1992).

The most important human component of the Gir ecosystem has been the resident maldharis (professional cattle owner) and their domestic livestock which have been an integral part of Gir for over 125 years. Based on 1971 census, 845 maldhari families and 556 forest settlement households were living in the PA (Anon., 1972). Approximately 44,000 domestic livestock including illegal entrant and 5,600 wild ungulates lived or grazed within the sanctuary. Analysis of Lion scats collected in 1971-72 throughout the sanctuary showed that about 75% of the Lion's diet was domestic livestock, reflecting its great availability and shortage of wild ungulates (Joslin, 1973).

Based on the recommendations of the research and study projects, the Gir Sanctuary Project was launched in 1971. Out of 845 maldhari families, about 2/3 have been settled outside in 29 different Settlements. The sanctuary was fenced by the rubble wall/barricades and protection

level was enhanced which resulted into recovery of habitat, drastic reduction in domestic livestock and increase in wild ungulate population from 9,800 in 1974 to over 38,000 in 1995. Although Lion population increased from 180 in 1974 to 304 in 1995 but its predation pattern shifted gradually from domestic livestock to wild ungulates due to increase in their population. The last 25 years have witnessed a complete reversal in the predation pattern of Lions in Gir and Lion's dependency on domestic livestock within the PA has reduced. Sinha (1987) reported that 52% of the scats he analysed contained wild prey. As per Ravi Chellam's study (Feb., 1987 to May, 1989) the composition of lions diet was 60 to 65% wild ungulates and 35 to 40% domestic livestock. The shift in the predation pattern is due to change in the availability of prey species within the Sanctuary and National Park. However, about 15% lions staying outside the PA still derive major share of their food from domestic livestock (Singh and Kamboj, 1995).

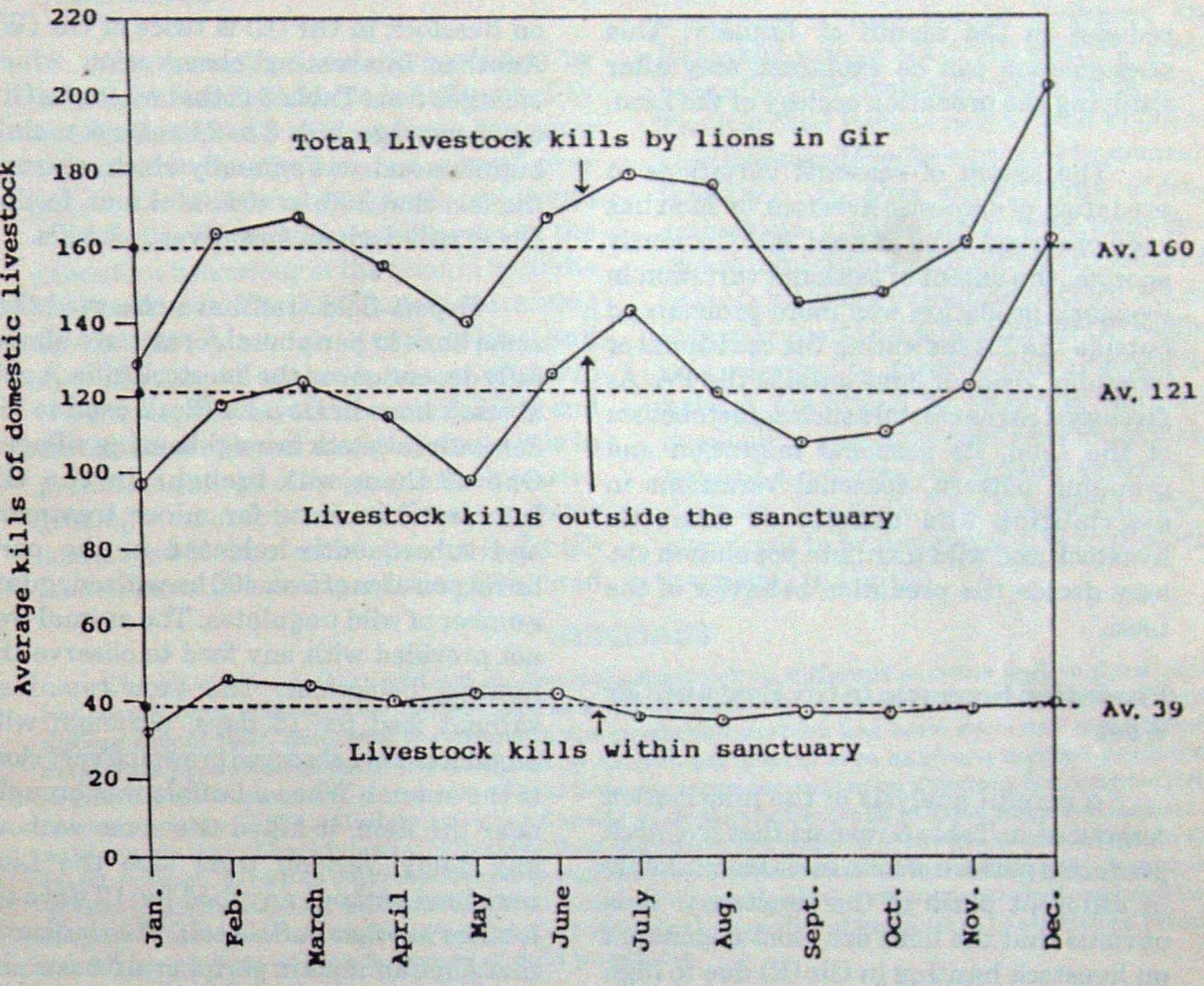
About 1,900 to 2,000 kills of domestic livestock by lions have been recorded annually in Gir during recent past. Yearwise kills of livestock by carnivores inside and outside the sanctuary in Gir (E) and Gir (W) division are given in Table 1.

As is evident from Table 1, domestic livestock killed by the carnivores recorded during severe drought of 1987-88 was lowest despite the fact that thousands of domestic livestock were grazing illegally in the sanctuary and peripheral forests. Due to the abundant availability of domestic livestock, the Lions predated extensively on them they it constituted an easy prey for these carnivores. People could not claim compensation for such illegal grazing. However, it resulted into escalation of predation of Lion on domestic livestock in subsequent years as the lions persistently killed livestock by intruding into the peripheral villages. Consequently, the incidences of Lion-human encounters increased leading to death of many people (Anon., 1995). It is noticed that Leopards do not kill livestock within PA probably because they are not able to kill bigger livestock such as buffaloes and cows found in the PA. However they kill small livestock such as goats, sheep etc. found outside the PA.

Seasonal variations in Lion's predation pattern on domestic livestock have been shown in Fig. 1. Interesting conclusions can be derived from these informations after co-relation Lion's migration pattern, social grouping, herbivores population density and availability of livestock with the predation pattern.

The average number of livestock kills within the PA remains constant at about 40/ month with slight variations in February-March and during rainy season from July to October. It is very difficult to explain these seasonal variations due to limitation of our knowledge about the requirement of food by the Lion in different seasons which may depend upon the metabolism of the animal. It is, in turn, observed from Table 2 that there is 15% increase in livestock kills within the PA during February-March which incidentally happens to be the peak littering season of Lion in Gir. Obviously, during parturition and post-parturition period movement of lioness and other females of the pride remains confined within the PA. The seasonal variation in metabolism of the animal and/or peak littering season may be the reason for escalation in magnitude of domestic livestock predation by Lion within the PA during February-March.

Fig. 1



Seasonal variation in predation on domestic livestock by the Lion in Gir

Maximum predation of Lion on livestock belonging to peripheral villages around Gir has been noticed during the beginning of rainy season i.e. in the months of June and July. Also the extent of predation by Lion on domestic livestock outside the PA was remarkably higher in the Gir (W) Division. This may be due to the fact that during rain season the lions prefer to live in the periphery of the sanctuary to avoid the pestering flies and insects in the sanctuary. Also there is maximum activity and movement of human being and domestic livestock in the agricultural fields during monsoon. Therefore, the probability of Lion-human and Lion-livestock encounters increases during this season resulting in enhanced killing of livestock in the peripheral villages. This is also corroborated from the Fig. 1 which indicates that domestic livestock kills inside the PA get reduced by over 10% whereas it increases by about 20% outside the PA. Further analysis from the Fig. 1 depicts an increase in the livestock predation during the first half of winter season (November and December) which

reduces in the month of January. This phenomenon can be explained only after studying the predation ecology of the Lion.

The extent of seasonal variations in predation of domestic livestock by Lion has been observed to be around 36% Curiously enough, the extent of seasonal variation in livestock predation was more pronounced outside the PA indicating the occasional or irregular visits of lions outside the PA. As discussed earlier factors such as metabolism of the Lion, its seasonal migration and grouping pattern, seasonal variations in distribution and density of domestic livestock and wild ungulate population etc. may decide the predation behavior of the Lion.

Predation Scenario in Gir East and Gir West

A careful analysis of the information computed in Table 3 reveals that livestock predation pattern of Lion varies remarkably in different parts of the sanctuary. It is obvious that the lions are more dependent on livestock hunting in Gir (E) due to high density of resident domestic livestock and low density of wild ungulate population.

Although area of Gir (E) is almost half of the area of Gir (W) yet the resident domestic livestock population is almost double. As the Lion population in Gir (E) is only 37% of the total the availability of domestic livestock per Lion is almost four times that of Gir (W). On the other hand, population of wild ungulates in Gir (E) is far lower than that of Gir (W). Availability of livestock population/Lion in GIR (E) is four times greater than Gir (W). Great variation in population densities caused major change in predation pattern of Lion. Lions predation on livestock in Gir (E) is twice of Gir (W). Another interesting observation which emerges from Table 3 is that a Lion in Gir, on an average, kills 8 to 9 livestock mainly buffaloes and cows annually which ascertain the fact that 30% to 40% of Lions' food in Gir is still derived form livestock kills.

Expert field staff have observed that some lions in peripheral forests are almost fully dependent on the livestock kills. A pair of adult lions in Devalia Block used to kill domestic livestock in neighbouring villages. One of them was brought in the Gir Interpretation Zone for minor treatment and subsequently released in the park having an area of over 400 ha with adequate number of wild ungulates. The animal was not provided with any food to observe the hunting behaviour. The Lion remained without food for 15 days, although wild ungulates were observed browsing very close to the animal. When a buffalo was brought near the Lion, it killed the same without any delay. Second time also the Lion remained without any food for 12 days till it killed another buffalo calf. This indicates that some animals in peripheral forests and satellitic zones have habit of killing domestic livestock.

Predation behaviour of Lion in the National Park is different as cattle are stranger to the animal. Once a bait was provided to adult Lion in the National Park and the Lion passed from near the buffalo calf and looked at the same but did not kill it. After some distance it killed an adult Sambar. Many such observations made by the Sikaris (expert in Lion trekking) ascertains that interaction of Lion with domestic livestock brings about a major change in predation behaviour of the great cat.

Conclusions

The domestic livestock predation by Lion has been observed to be influenced by various factors such as abundance, temporal and spatial distribution and size of prey population. Seasonal variations inside and outside the PA have been observed in the predation behaviour of the lions in both the forest division. Further, factors pertaining to habitat such as availability and distribution of ambush cover, climatic conditions, terrain and the availability and distribution of water also play major role in predation ecology of the great cat. Excessive grazing pressure of domestic livestock, water scarcity and lack of ambush cover in Gir (E) lead to more livestock predation by Lion in that region. The population density of wild ungulates is very low in Dalkania and Khambha ranges of Gir (E) which is also a zone of higher livestock predation by Lion. The National Park is rich in wild ungulate population and free form grazing by domestic livestock. In this zone, lions almost exclusively predate upon wild ungulates and exhibit different hunting instincts. In order to alter the predation pattern of Lion in favour of wild ungulates in Gir (E) region, it is essential to improve and upgrade the habitat conditions by ensuring adequate availability and proper distribution of water holes and reducing the grazing pressure of domestic livestock. The vegetation cover also needs to be improved in favour of wild ungulates in Gir (E).

SUMMARY

The predation pattern of Lion on domestic livestock in different seasons and regions of Gir Sanctuary have been studied. About 1,900 to 2,000 domestic livestock were killed by lions annually during recent past. Seasonal variations in the predation pattern has been recorded in which the maximum predation of domestic livestock by Lion in peripheral area has been noticed during the beginning of rainy season. It is observed that lions are more dependent on livestock hunting in Gir(E) as compared to Gir(W). High population density of domestic livestock creates negative impact on wild population of herbivores which also affect the predation pattern of the great cat. A Lion in Gir, on an average, kills 8 to 9 livestock mainly buffaloes and cows annually ascertaining the fact that 1/3 of the Lions' food is still constituted by the domestic livestock. Management prescriptions have been suggested to improve the habitat in some part of Gir in the benefits of herbivores to alter the livestock predation pattern of Lion in favour of wild ungulates.

पालतू पशुओं पर एशियाई सिंह की शिकार करने की रूप-सज्जा

एच०एस० सिंह व आर०डी० कम्बोज

सारांश

गीर अभयारण्य में पालतू पशुओं पर विभिन्न मौसमों और विभिन्न क्षेत्रों में सिंह द्वारा उनका शिकार करने की रूप-सज्जा का अध्ययन किया गया। विगत अतीत में लगभग 1900 से 2000 पालतू पशु प्रतिवर्ष सिंहों ने मारे है। शिकार करने कि सज्जा की मौसमी विभिन्नता का अभिलेखन किया गया है। जिसमें सिंह द्वारा पालतू पशुओं का अधिकतम शिकार चौगिर्द वाले क्षेत्र में बरसात में होता देखा गया है। यह भी देखा गया है कि सिंह गीर (पशिचम) की तुलना मे गीर (पूर्व) में पशुओं का शिकार करने पर ज्यादा निर्भर है। पालतू पशुओं का अधिक सँख्या घनत्व जंगली शाकभोजी पशुओं की संख्या पर नाकारात्मक प्रभाव डालता है और इस महा बिडाल की शिकार करने की सज्जा पर उसका भी प्राभाव है। गीर में एक सिंह औसतन 8 से 9 पशु मुख्यत: भैस और गाय मारता है जिससे यह पता लगता है कि सिंह के भोजन का एक तिहाई भाग अब भी पालतू पशुओं से मिल रहा है। गीरके कुछ भागों में प्राकृतावास को शाकभोजी पशुओं के लाभार्थ सुधारने के लिए ताकि सिंह की पालतू पशुओं को मारने की सज्जा बदलकर जंगली शफीयों को मारने की बन जाए कुछ प्रबन्धोपाय भी सुझाए गए हैं।

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FOOD HABITS OF MAMMALIAN PREDATORS IN PERIYAR TIGER RESERVE, SOUTH INDIA

K.K. SRIVASTAVA[1], A.K. BHARDWAJ[2], C.J. ABRAHAM[3] AND V.J. ZACHARIAS[4]

Periyar Tiger Reserve, Thekkady (Kerala)

Introduction

Very little information is available on the food habits of major mammalian predators in the tropical wet evergreen habitats of India, though some published data is available on the topic for other habitats of the subcontinent (Schaller, 1977; Mc Dougal, 1977; Johnsingh, 1983). Rice (1986) based on his observation in the Eravikulam National Park, has given a scanty account of the prey predator relations. But a systematic study on the topic was not conducted so far in the habitat.

The above studies show that Tiger (*Panthera tigris*). Leopard (*Panthera pardus*) and the wild Dog (*Cuon alpinus*) are the major mammalian predators in India. Their main prey species comprise the Chital (*Axis axis*) the Hog Deer (*A. procinus*, the Sambar *(Cervus unicolor)* and the Swamp Deer (*C. duvanceli*). The Barking Deer (*Muntiacus muntjac*), the Nilgai (*Boslaphus tragocamelus*), the Wild Boar (*Sus scrofa*), the Gaur (*Bos gaurus*), the Porcupine (*Hystrix indica*) and the Blacknaped Hare (*Lepus nigricollis*) are also preyed on by the above predators. Tiger in adition to the above, was reported to prey on the Elephant (*Elephas maximus*) calves, the Common Langur (*Presbytis entelles*) and domestic livestock. Leopard's prey included Nilgiri Langur (*Presbytis johnii*) and the Nilgiri Tahr (*Hemitragus hylocrius*), Wild Dogs were reported to prey on Mouse Deer (*Tragalus meminna*) also.

A study on the food habits of the major mammalian predators, the Tiger, the Leopard and Wild Dogs were carried out in Periyar from September 1991 to December 1994. The objective of the study was to identify the prey species of the major predators and to find out the proportion of different prey species consumed by the major predators in the reserve where the common prey species Chital, Hog Deer and Swamp Deer are totally absent.

Methods

Studies were centered around 4 localities in Periyar Tiger Reserve. These places were selected on the basis of habitat types. Four transects, each were held in the forest three localities and 2 in the fourth. These transects having an average length of 8 km were covered once every month.

Two data collectors and 2 local tribesmen assisted throughout the study. Direct sightings of Tiger, Leopard and Wild Dogs and indirect evidences of their

1. Field Director (Project Tiger) 2. Wildlife Preservation Officer
3. Data Collector, 4. Research Officer

Table 1

Tiger - Frequency of occurrance of prey remains in Scats in Periyar (1991-1994)

Month and Year	Total scats	Sambar	Porcupine	Small Rodents	Mouse Deer	Nilgiri Langur	Small Indian Civet.	Black-naped Hare	Varanus	Wild Gaur	Wild Boar	Elephant	Domestic cattle	Grass
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
September 91	6	5	1	1	-	-	-	-	-	-	-	-	-	2
October "	8	4	1	3	-	-	-	-	1	-	-	-	-	-
November "	2	2	-	-	-	-	-	-	-	-	-	-	-	-
December "	7	5	-	1	-	-	1	-	-	-	-	-	-	1
January 92	8	7	1	-	-	-	-	-	1	-	-	-	-	-
February "	1	1	-	-	-	-	-	-	-	-	-	-	-	-
March "	15	13	2	2	-	1	-	1	-	-	-	1	-	2
April "	3	3	1	-	-	-	-	-	-	1	-	-	-	1
May "	6	3	3	-	-	-	-	-	-	-	1	-	-	-
June "	1	1	1	-	-	-	-	-	-	-	-	-	-	-
July "	1	1	1	-	-	-	-	-	-	-	-	-	-	-
August "	1	-	-	1	-	-	-	-	-	-	-	-	-	-
September "	2	2	-	-	-	-	-	-	-	-	-	-	-	-
October "	2	2	-	-	-	-	-	-	-	-	-	-	-	-
November "	1	-	-	-	-	-	1	-	-	-	-	-	-	-
December "	5	2	2	-	-	1	-	-	-	-	-	-	-	-
January 93	3	-	2	-1	-	-	-	-	-	-	-	-	-	-
February "	2	1	1	-	-	-	-	-	-	-	-	-	-	-

Contd...

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
March 93	1	1	-	-	-	-	-	-	-	-	-	-	-	-
April "	5	-	3	-	-	-	-	2	-	-	-	-	-	2
May "	4	2	1	-	1	-	-	-	-	-	-	-	-	-
June "	1	-	-	-	1	-	-	-	-	-	-	-	-	-
July "	1	1	-	-	-	-	-	-	-	-	-	-	-	-
August "	3	1	-	-	1	-	-	-	-	-	-	-	1	-
September "	5	3	2	-	-	-	-	-	-	-	-	-	-	2
October "	2	2	-	-	-	-	-	-	-	-	-	-	-	-
November "	3	2	1	-	-	-	-	-	-	-	-	-	-	-
December "	1	1	-	-	-	-	-	-	-	-	-	-	-	-
January 94	2	2	-	-	1	-	-	-	-	-	-	-	-	-
February "	4	3	1	-	-	-	-	-	-	-	-	-	-	-
March "	5	3	2	1	1	-	-	-	-	-	-	-	-	-
April "	3	2	-	-	-	-	1	-	-	-	-	-	-	1
May "	2	2	-	-	-	-	-	-	-	-	-	-	-	-
June "	1	1	-	-	-	-	-	-	-	-	-	-	-	-
July "	1	-	1	-	-	-	-	-	-	-	-	-	-	-
August "	2	2	-	1	-	-	-	-	-	-	-	-	-	-
September "	1	1	-	-	-	-	-	-	-	-	-	-	-	-
October "														
November "														
December "														
Total	121	81	27	10	6	2	3	3	2	1	1	1	1	12
Percentage	66.9%	22.3%	8.26%	4.9%	1.6%	2.4%	2.4%	1.6%	8%	8%	8%	8%	9.9%	

Table 2

Leopard - Frequency of occurrance of prey remains in Scats in Periyar (1991-1994)

Month and Year		No. of scats collected	Sambar Langur	Nilgiri	Rodents	Flying-Squirrel	Mouse Deer	Small Indian Civet
September	91	2	-	2	-	-	-	-
October	"	2	-	2	-	-	-	-
November	"	2	-	2	-	-	-	-
December	"	3	-	3	-	-	-	-
January	92	7	-	6	-	1	-	-
February	"	8	2	6	-	-	-	-
March	"	6	2	4	-	-	-	-
April	"	7	2	6	-	-	-	-
May	"	2	-	2	-	-	-	-
June	"	2	-	2	-	-	-	-
July	"	3	-	3	-	-	-	-
August	"	5	-	5	-	-	-	-
September	"	3	1	2	-	-	-	-
October	"	2	-	2	-	-	-	-
November	"	2	1	1	-	-	-	-
December	"	2	1	2	-	-	-	-
January	93	5	-	4	-	-	-	-
February	"	4	-	-	-	1	3	1
March	"	2	1	2	-	-	-	-
April	"	3	-	3	-	-	1	-
May	"	1	-	1	-	-	-	-
June	"	1	1	-	-	-	-	-
July	"	1	-	1	-	-	-	-
August	"	2	-	2	-	-	-	-
September	"	1	-	1	-	-	-	-
October	"	2	1	1	-	1	-	-
November	"	2	-	2	-	-	-	-
December	"	1	-	1	-	-	-	-
January	94	3	1	2	1	-	-	-
February	"	2	-	1	-	-	1	-
March	"	3	1	2	-	-	-	1
April	"	1	-	1	-	-	-	-
May	"	2	-	2	-	-	-	-
June	"	1	-	1	-	-	-	-
July	"	1	-	1	-	-	-	-
August	"	-	-	-	-	-	-	-
September	"	1	-	1	-	-	-	-
Total		97	14	79	2	3	6	2
Percentage	-	14.43%	81.44%	2.06%	3.09%	6.18%	2.06%	

Table 3

Wild Dog - Frequency of occurrance of prey remains in Scats in Periyar (1991-94)

Month and Year	No. of scats	Sambar	Mouse Deer	Barking Deer	Nilgiri Langur	Rodents	Porcupi pine.	Grass
September 91	6	6	-	-	-	-	-	-
October ”	8	6	1	-	1	1	-	1
November ”	6	5	1	-	-	-	-	-
December ”	9	6	-	1	2	2	-	-
January 92	6	4	-	-	-	1	-	2
February ”	5	5	-	-	-	1	-	-
March ”	4	4	-	-	-	-	-	-
April ”	3	3	-	-	-	-	-	-
May ”	5	5	-	-	-	-	-	-
June ”	3	3	-	-	-	-	-	-
July ”	4	4	-	-	-	-	-	1
August ”	3	3	-	1	-	-	-	-
September ”	9	8	1	-	-	-	-	-
October ”	5	5	-	-	-	-	-	-
November ”	6	6	-	-	-	-	-	-
December ”	5	4	-	1	-	-	-	2
January 93	4	4	1	-	-	-	-	-
February ”	7	5	1	-	-	-	-	-
March ”	9	8	1	-	-	-	-	4
April ”	5	5	-	-	-	-	-	3
May ”	10	9	1	-	-	-	-	-
June ”	7	7	-	1	-	-	-	-
July ”	3	3	-	-	-	-	-	-
August ”	6	4	1	-	-	-	1	-
September ”	4	3	1	-	-	-	-	1
October ”	5	5	1	-	-	-	-	-
November ”	3	2	-	1	-	-	-	-
December ”	6	5	1	-	-	-	-	-
January 94	5	5	-	-	-	-	-	1
February ”	4	3	-	1	-	-	-	-
March ”	8	6	2	-	-	-	-	2
April ”	9	8	-	-	-	-	-	-
May ”	5	4	-	-	-	1	-	-
June ”	3	3	-	-	-	-	-	-
July ”	2	2	-	-	-	-	-	-
August ”	6	5	1	-	-	-	-	1
September ”	3	3	-	-	-	-	-	-
Total	201	176	14	6	3	6	1	18
Percentage	87.56%	6.96%	2.98%	1.49%	2.98%	0.49%	8.95%	

occurrence such as pug-marks, kills and scats were recorded on these transects. While walking, alarm calls of Sambar, Nilgiri Langur and Squirrels were listened and their possible causes investigated. This helped to get more information on predators and their prey species.

Details of kills such as teeth, antlers and bones were recorded to determine the approximate age and health of prey species. Scat samples were collected, washed well in hot water and their contents dried.

The hairs in these samples were compared with fresh hair samples collected from kills, carcasses and zoo animals, which were used as reference materials. The reference materials were processed using methods suggested by Adorjan and Kolensky (1980) and Koppikar and Sabinis (1976).

Results and Discussions

Studies conducted over a period of three years show, Sambar constituted 66.9% and Porcupine 23.3% of the prey consumed by Tiger in Periyar (Table 1). The Gaur, the Wild Boar, the Elephant (Calf?), the Nilgiri Langur, the Blacknaped Hare, Rodents, the Small Indian civet and the Varanus are also preyed on by Tiger here.

The Leopards in the Reserve preyed mostly on the Nilgiri Langur (81.44% Table 2). Other prey species of Leopard consisted of the Sambar (14.43%), the Large Flying Squirrel and Rodents.

Sambar is the major prey species of Wild Dogs (87.56%) in Periyar (Table 3) Wild Dogs here also preyed on Barking Deer (2.98%), Mouse Deer (6.96%), Nilgiri Langur and Rodents. Grasses in good quantity were observed in 2 Wild Dog scats. Wild Dogs were once observed chasing a Wild Boar to the lake in an unsuccessful attempt to prey on the animal. It is hence likely that the Wild Dogs may also prey on Wild Boar here as observed by Johnsingh (1983) in Bandipur.

The available data show some interesting pattern in the prey-predator relations. The absence of major prey species such as Chital, Hog Deer and Swamp Deer in Periyar seems to be compensated by taking a large proportion of Sambar and Porcupine and other prey species like Small Indian Civet, Nilgiri Langur and Varanus by Tiger. In this connection it may also be noted that Sambar formed 11.7% of the prey species of Tiger in Kanha, 29.3% in Royal Chitwan, Nepal and 31.1% at Bandipur whereas the proportion of Sambar prey in Periyar is 66.9% for Tiger. Consumption of a higher proportion of Porcupine (22.3%) is worth mentioning.

Regarding Leopard the Nilgiri Langur comprises 81.44% of its prey in Periyar. This is a higher percentage when compared with the data of Rice (1986) in whose study area at Eravikulam the Nilgiri Tahr formed a major prey of Leopards.

The number of scats collected however will not be enough to make any conclusion in this case. But it may be noted that the Nilgiri Langur has a wide distribution in Periyar and is an easily available prey species for Leopards here. The Nilgiri Tahr occurs only in very small numbers here and that too, in isolated pockets. Though Leopards also prey on Sambar they may have to compete with Tiger and Wild Dogs for this species.

Sambar formed the major prey species

of Wild Dogs in Periyar (87.56%). At Bandipur Sambar constituted 14%, Chital 50% and Blacknaped Hare 13% of the prey species of Leopard. The increasing frequency of Wild Dogs preying on Sambar in Periyar may be due to the absence of Chital here.

Acknowledgements

We are grateful to Dr. J.F. Bendell, Professor of Wildlife, University of Torento for his suggestions in carrying out the work. Thanks are due to Shri C.K. Karunakaran, IFS, former Chief Conservator of Forests (Wildlife) for his guidance and encouragement for the first phase of this study. Encouragements received form Shri P.K. Surendranathan Asari, IFS, Chief Conservator of Forests (Wildlife) is gratefully acknowledged.

SUMMARY

This study has identified new prey species of the major mammalian predators in Periyar Tiger Reserve; Nilgiri Langur, Elephant and Varanus for Tiger and Flying Squirrel for Leopard. The proportion of different prey species taken by these predators is also interesting.

पेरियार बाघ आरिक्षित क्षेत्र, दक्षिण भारत में स्तनि शिकारी पशुओं की भोजन आदतें

के०के० श्रीवास्तव, ए०के० भारद्वाज, सी०जे० अब्राहम व वी०जे० जकरियास

सारांश

इस अध्ययन में मुख्य स्तनि शिकारी पशुओं के लिए पेरियार बाघ आरक्षित क्षेत्र में कुछ नई शिकार बनने वाली जातियों को बताया गया है - नीलगिरि लँगूर, हाथी और बेदार छिपकली बाघ के लिए तथा उडती गीलहरी तेन्दूए के लिए । इन शिकारी पशुओं द्वारा ग्रहीत शिकार जातियों का समानुपात भी रोचकता भरा है ।

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CROP DEPREDATION AROUND JALDAPARA SANCTUARY BY *RHINOCEROS UNICORNIS* AN INDICATIVE TREND

DEEPAK K. GHOSH*

Introduction

Replenishing natural diet with agricultural crops is usually associated with bulk and roughage and mixed feeders, generally having a herd composition. Invariably with these animals are involved some kind of migration, either on a fixed long route (e.g. Elephant) or local on a much lower scale (e.g. Gaur) and most depredation takes place during such migratory movement. Others involve large herds multiplied beyond the carrying capacity of the holding forest tract (e.g. Spotted Deer) and unable to meet required energy demands from the resident area have proved a menace to agricultural crops.

Contrary to this general trend, the great Indian One Horned *Rhinoceros unicornis* an individualistic animal with fixed home ranges had never been a habitual crop raider. Contrary to this an incursion to one's field was considered an auspicious omen. Such was the rarity of its visit.

This belief is now a thing of past. Levels of crop depredation by *Rhinoceros* is now a menace, in Kaziranga, where special crop protection forces had to be compulsively created to prevent depredation of paddy fields around the park. If not to similar extents, the crop depredation by Jaldapara Rhinos are also on a sharp increasing trend and is already proving to be a menace in a few pockets.

Significant levels of crop raiding incidence has been noted in 'Torsa East Camp' and 'Moiradanga' specially in two males and one female with young calf from 1985 onwards and in 'Sisamara' since 1989 by two male and one female with a sub adult calf. Frequency of raiding incident is 2 to 3 times a week, usually between 10.30 p.m. to 3.30 a.m. in the months of September, October and November. The most preferable crop is paddy, in the process of maturing, through the 'Monikarjee Ghat of Khawchang Para' constant raids of pulses have been noticed. Whereas the these animals have become habitual crop raiders, cursory visits by other Rhinos in the area is also on an increase.

Possbile Factors

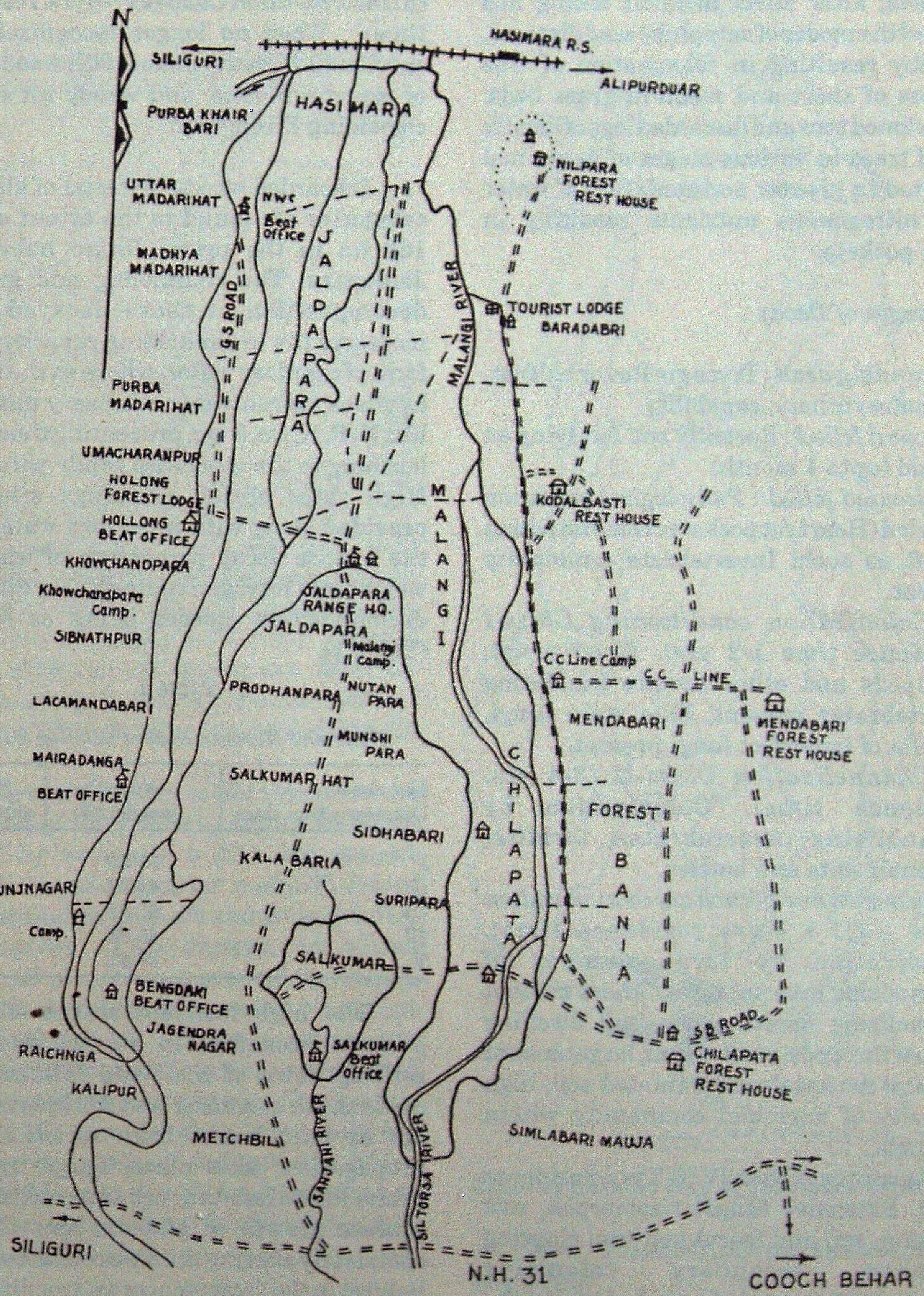
Reasons for this anomalous behaviours cannot be attributed to one single factor. Various cause effects in itself and also often interdependent on each other have resulted in certain cumulative effects, crop damage being one of them.

Analysis of Cause Effects

(1) *Habitat* : The peculiar trouser shape of the sanctuary, densely populated villages along the periphery (Fig. 1) and subsequent habitat destruction in the forms of illicit felling of trees, firewood and fodder grass removal and cattle grazing in the past had altered the natural ecological balance of the sanctuary. Apart from the direct loss of

* Divisional Forest Officer, Working Plans Division (N), Darjeeling (West Bengal).

Fig. 1



Location of villages in and around the Jaldapara Sanctuary

biomass, after effect of illicit felling has altered the modes of aerophilic seed disposal, thereby resulting in colonization of tree species of short and medium grass beds. Abandoned tops and discarded logs of illicitly felled trees in various stages of decay had resulted in greater accumulation of water and nitrogenous nutrients resulting in wood pockets.

(2) *Stages of Decay* :

(a) *Standing dead* : Trees girdled or half cut, no photosynthetic capability.
(b) *Sound felled* : Recently cut, left lying on ground (upto 1 month)
(c) *Diseased felled* : Pathological condition revealed (Heart rot pocket rot etc.) on felling or left as suchi Invertebrate community present.
(d) *Colonization conditioning Class-I* (residence time 1-2 yrs). Wood moist, Diplopods and other surface inhabiting invertebrates present, blue stain fungi, mycelia of imperfect fungi present.
(c) *Channelization Class-II* (3-4 yrs. residence time). Colonization by channelizing invertebrates, termite, carpenter ants and battles.
(f) *Succession and Secondary channelization Class - III* (4-yrs residence time). Colonization by large number of channelizing invertebrates, others without channelizing mouth parts, soil dwelling microarthropods, earth worm, large amount of faecal material contaminated soil, high diversity of microbial community within channels.
(g) *Maceration Class-IV* (6-7 yrs. residence time). Extensive fungal rizomorphs, root invasion, soil and feacal material clogging chamber, secondary colonizing invertebrates and fungal dominance obvious.
(h) *Incorporation Class-V* (7-8 yrs. residence time). Wood no longer recognizable by species 20-30% soil mixed with wood, mass of mycelia fibrous, and woody rot system colonizing throughout.

Discarded woody material of all these categories are found to the extent of 100-160 ha in the prime Rhino habitat in Jaldapara. The channeling and gradual decomposition of these decayed wood increases the water holding capacity in the form of capillary water, where as the fungal hyphaes concentrates necessary nutrients like N, P, K, Ca, S etc. preventing them from leaching in the otherwise sandy porus soil. High rates option exchange sites are provided along with necessary water once the hyphse decay percentage of water by weight and nitrogen content(x) in different decomposition classes being as follows (Table 1).

Table 1

Water and Nitrogen content % in log classes

Log class/ Decomposition class	Water by weight (%)	Nitrogen content (%)
I	37.62	0.07
II	43.79	0.10
III	57.82	0.13
IV	66.68	0.16
V	69.81	0.28

The high nutrient status of those pockets immediately attract and help settling down of the weed *"Mikenia (M. cordata, M. scandens* and *M.* hybrid*)*, and act as seed banks from which farther propagation takes place. Large tracts of prime Rhino habitats has been oblitered by profuse growth of *Mikenia* spp. (Fig. 2) completely altering the nature of the original habitat in the form of cover and modification of organic matter content and soil pH.

Table 2

Organic matter content(x) and soil pH in heavily affected Mikenia areas

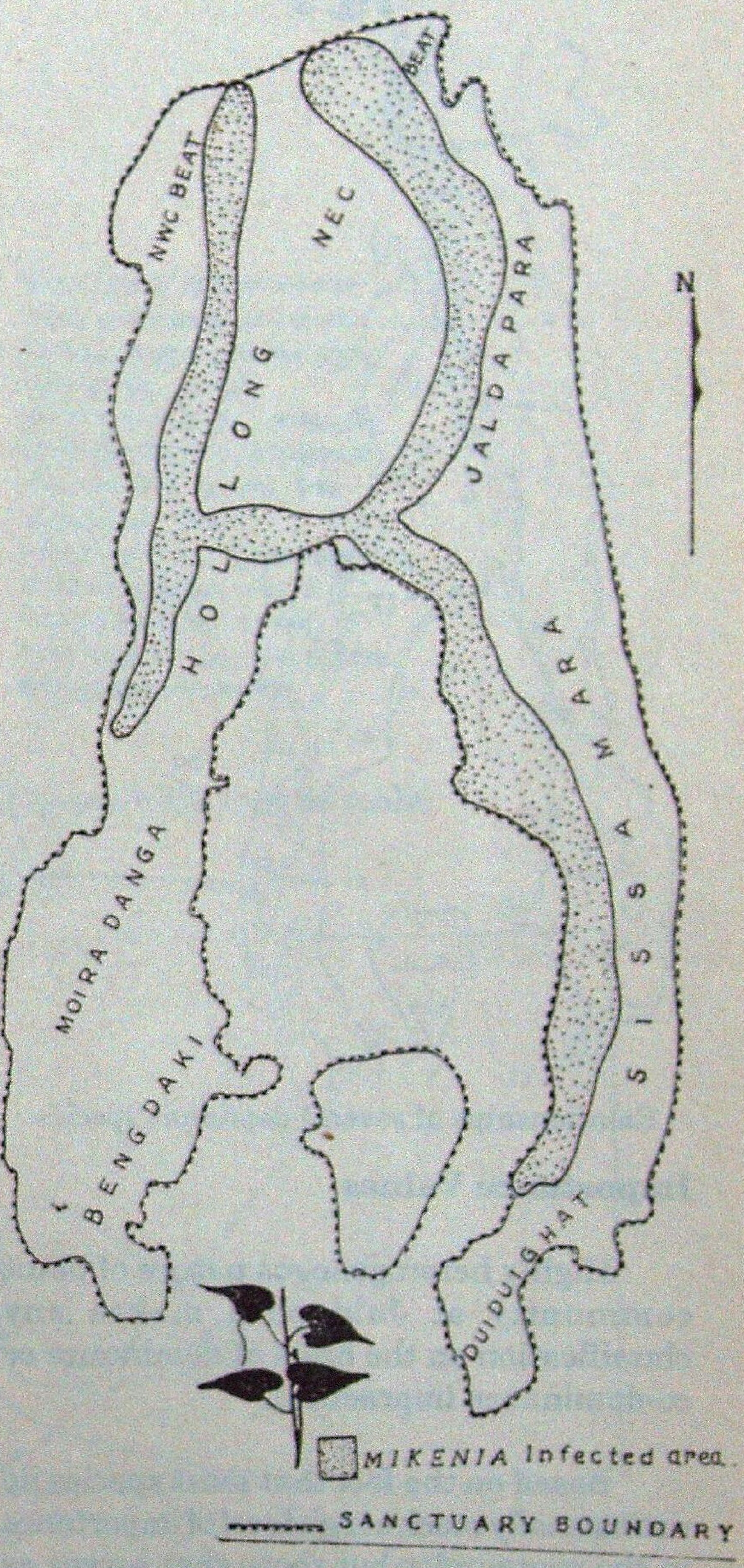
Site No.	Organic matter	pH
1.	37	5.2
2.	42.8	5.6
3.	41.8	6.1
4.	57	5.5
5.	33.6	5.5
6.	35.6	5.6
7.	54.4	5.1
8.	48.8	5.2
9.	56.2	5.6
10.	47.8	5.5
	Av % = 45.48%	Av pH = 5.49

Whereas a weakly alkaline pH (7-7.5) is suited for grassland development, change to weakly acidic soil pH prohibits the proliferation of grass in *Mikenia* affected areas, without soil treatment. *Mikenia* propagation to the extent of almost 20% of the prime Rhino habitat is recorded (Fig. 2).

The overall effect of disturbances and the trend of the habitat pattern has been studied by means of a plot less system, "Bitterlicks point quarter method". Based on the actual pattern of random vegetative distribution of Jaldapara, in which individual plants/trees are widely spaced, and with the underlying assumption that individuals of all species together are randomly dispersed this system was adopted as it does not produce any significant error. Thirty (30) sample plots were selected covering the present and possible Rhino areas and at each site 50 readings taken at 10 m interval over 3 years readings averaged for the deduction of :

(a) Relative density of each species.
(b) Frequency of each species.
(c) Relative frequency of each species.

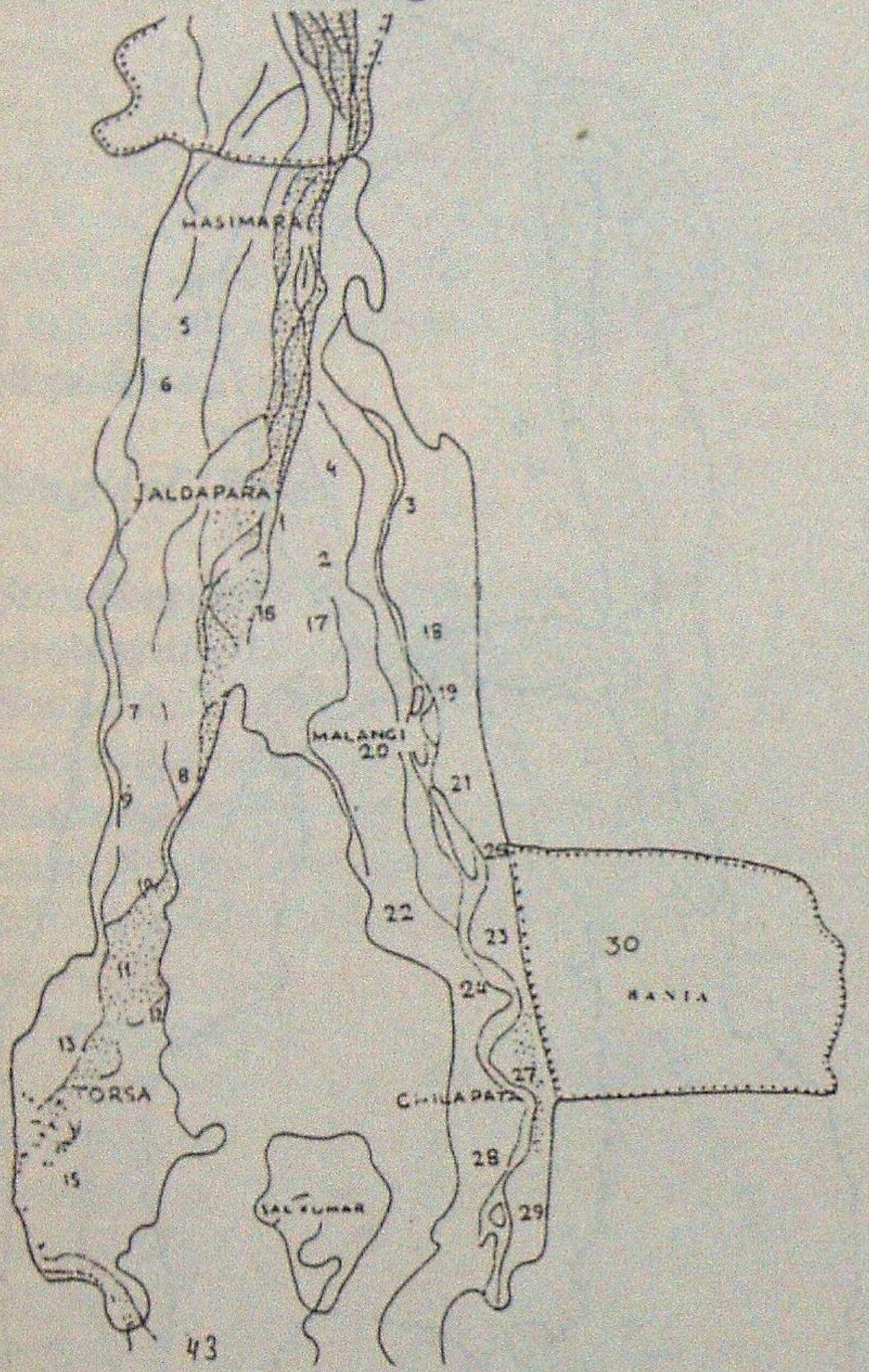
Fig. 2



Mikenia infested area in Jaldapara Sanctuary

From these data inferences were drawn regarding
(i) Importance value
(ii) Ecological sequence number.
(iii) Continuum index.

Fig. 3



Relationships of several dominant species

Importance Values

Highly heterogeneous nature of plant community at Jaldapara makes any classification on the basis of dominance or co-dominance impractical.

Based on the fact that most species do not normally reach a high level of importance in the community but those that serves as an index guiding species Importance Value is derived by taking a sum of relative density and relative frequency of each species involved (Curtis and Meintosh, 1951). Importance value thus obtained for species in stand enables grouping of stands by leading dominance and groups can be placed in an logical order based on the relationships of several dominant species.

Ecological Sequence Number

Based on the figures of frequency, relative frequency and relative dominance 'Ecological sequence number' is obtained by first assigning ecological adaptation to various species.

For this a 10 part scale has been established for Jaldpara Sanctuary as follows (Table 3).

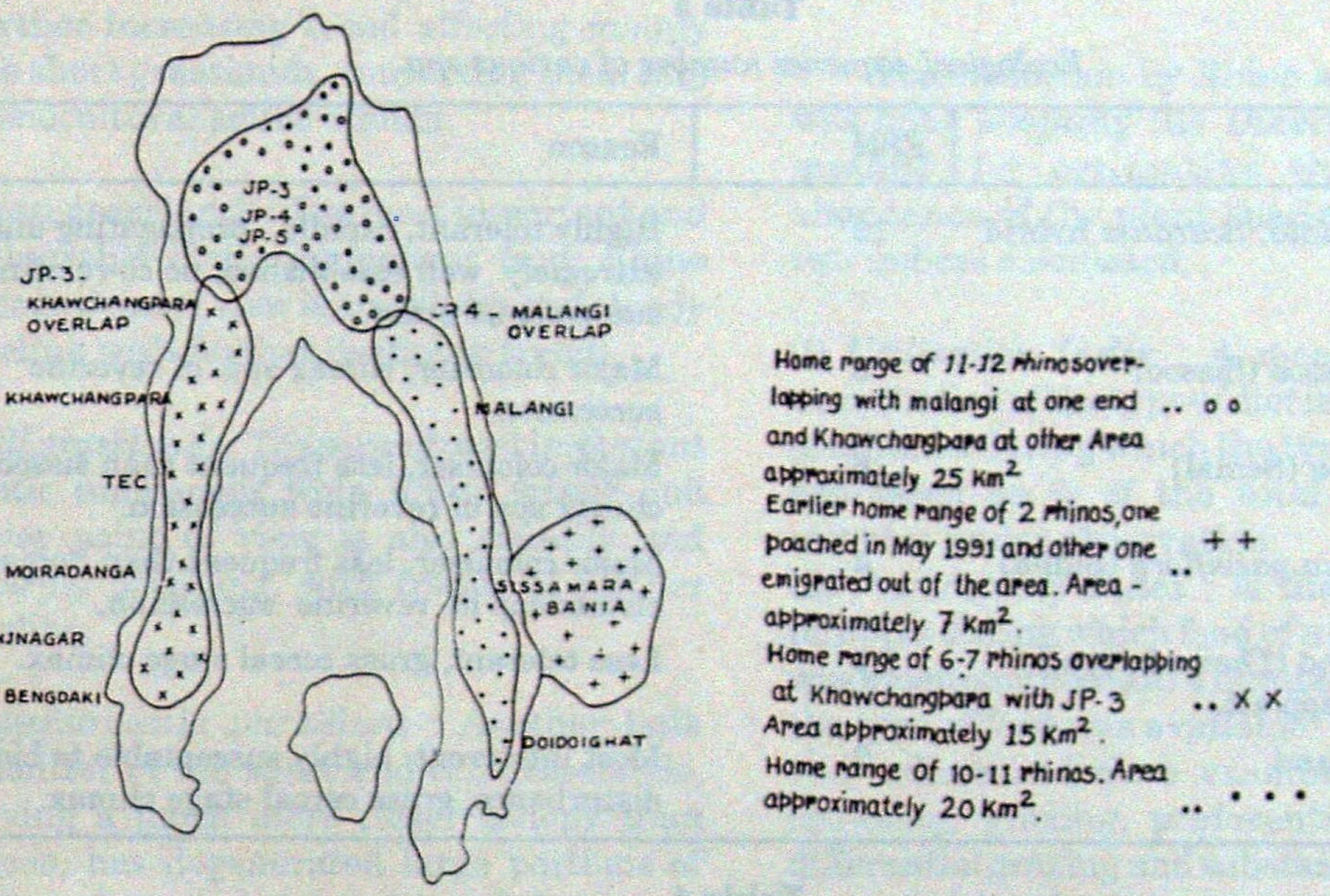
Continuum Index : The importance value has further been expanded into a composite figure "Continuum Index" for comparison of a large number of stands observation that each species reaches it best development in stands whose position bears a definite relation to that of other species, varying continuously along a gradient. continuum Index is obtained by multiplying the importance value of each species with its ecological sequence number and values of all species in the stand added. The sum is the stand continuum index. This is used to place that stand on continuum scale that runs from 300 to 3000 (Curtis and Meintosh, 1951). After the stand indices has been calculated the position of the individual species can be plotted in relation to the position of the stand on the index (Fig. 5).

Inference

Mikenia spp : Highest continuum index indicates prolific increase and further increasing trend, affecting and obliterating mainly the short and tall grasslands the primary grazing ground of the Rhino.

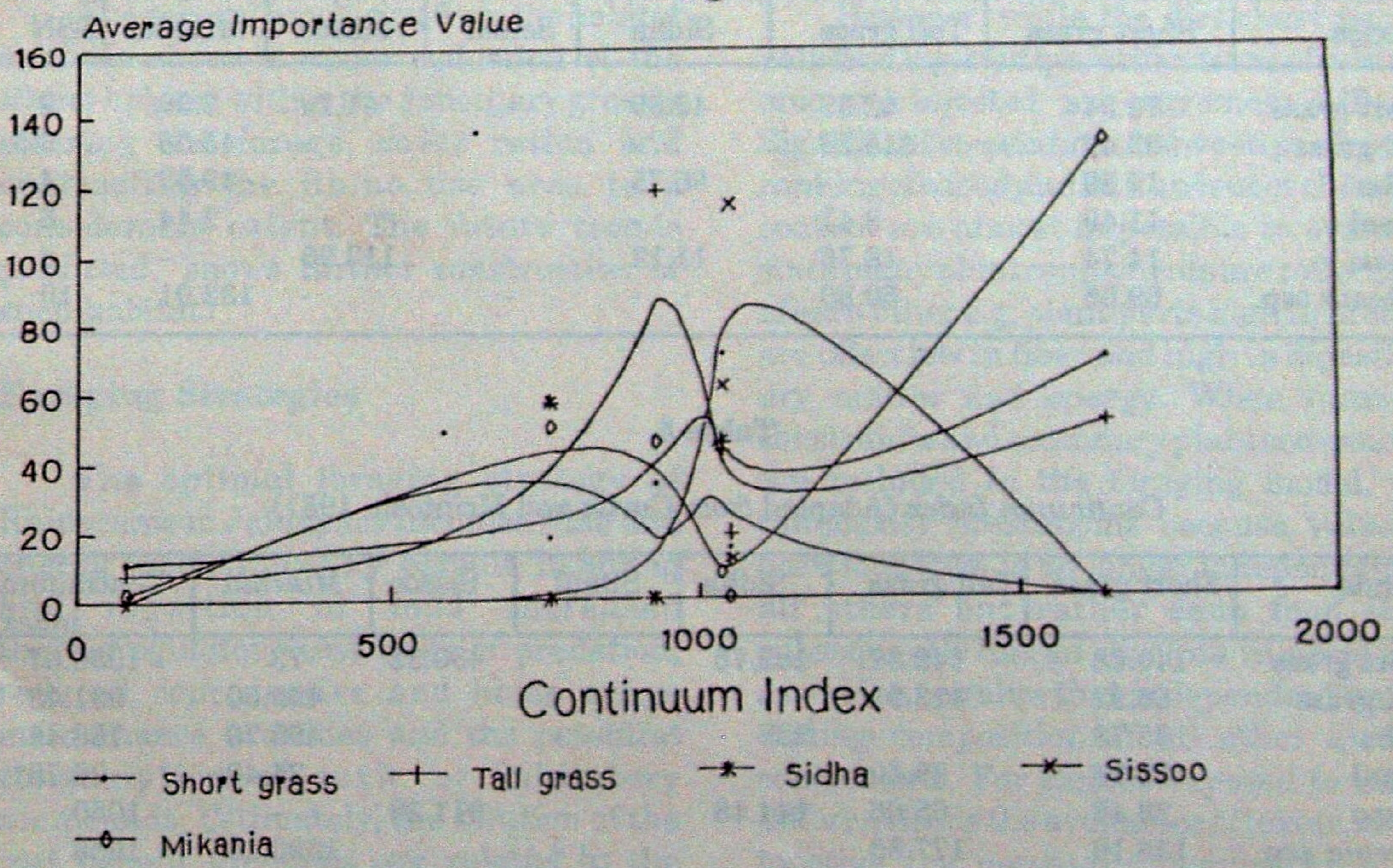
Dalbergia sissoo : Secondary colonizing

Fig. 4



Rhino home ranges in Jaldapara WLS (not to scale)

Fig. 5



Distribution of 5 forest species on a Continuum Index (after Curtis and Mcintosh, 1951)

Table 3

Ecological sequence number of various spp.

Species	ESN	Reason
Mikenia cordata, Scardass hybrid	10	Highly tolerant, rapidly, propagating and extremely well established, no co-relating successional order.
Dalbergia sissoo (Sissoo)	8	Major coloniser, climax spp. of reverine succession.
Bombax ceiba (Semal)	6	Major coloniser, less frequent than sissoo, climax spp of reverine succession.
Lagerstroemia parviflora (Sidha)	4	Major coloniser, less frequent than Semal, climax spp of reverine succession.
Tall grassland (*Themeda* spp.) *Phragmites* spp etc.	3.5	Less tolerant, grass cereal stage climax.
Short grassland	2	Most intolerent, highly susceptable to biotic disturbance, grass cereal stage climax.

Table 4

Average importance value of leading dominant species and respective ecological sequence number

Species	Short grass	Tall grass	Sidha	Semal	Sissoo	*Mikenia*	ESN
Short grass	70.34	42.66	45.69	-	61.29	7.30	2
Tall grass	33.46	118.26	-	-	-	45.06	3.5
Sidha	17.89	-	56.75	-	-	49.57	4
Semal	11.49	8.41	-	-	-	2.44	6
Sissoo	14.74	18.76	11.12	-	113.90	-	8
Mikenia ssp.	69.05	50.80	-	-	-	132.01	10

Table 5

Continuum Index (Adapted from Curtis and Mcintosh, 1951)

Stands	Short grass	Tall grass	Sidha	Simul	Sissoo	*Mikenia*	Continuum index
Short grass	140.68	149.31	182.76	-	490.32	73	1036.07
Tall grass	66.92	413.91	-	-	-	450.60	931.43
Sidha	35.78	-	227	-	-	495.70	758.48
Semal	22.98	29.40	-	-	-	24.40	76.78*
Sissoo	29.48	65.66	144.48	-	911.20	-	1050
Mikenia ssp.	138.10	177.80	-	-	-	1320.10	1636

* Eliminated from illustration because of zero importance value.

species with massive propagation and further increasing trend affecting mainly the short grasslands, converting them into monocultural sissoo stands.

Short grasslands : The most important and vulnerable biotic component from Rhino forage point of view is on a sharp and steady decline with further declining trend.

Tall grasslands : The second most important biotic component from Rhino forage and cover point of view is also steadily and sharply declining, with trends of further decline.

Lagerstroemia parviflora : Another bulk colonizer of the short and tall grasslands, having a much more closer canopy than sissoo, has degenerated large portions of Rhino foraging grounds and is on an increasing trend.

The general conclusion from the habitat analysis shows a major reduction of the Rhino habitat within the sanctuary grossly altering the forage, cover ration and contracting the Rhino use area to a considerable extent. The future trends predicted shows further construction of such habitat.

Foraging Strategies

The optimal foraging strategy of Rhinoceros in Jaldapara includes time and energy expenditures for persuit, handling and ingestion of food increased thermoregulatory cost risks of predation, reduced reproductive and home range maintenance activities and the potential consumption of toxic or inhibitory compounds. Ultimately, the solution of the cost benefit functions are related to the biological fitness of the forager.

Food Selection

Food selection by Rhino at Jaldapara was done adopting the Dinerstein (1975) method, for estimating the order of abundance of the plant species eater and two indices calculated.

(i) *Utilisation Index* : A measure of the contribution of the type of diet is the number of minutes during which the type was eaten expressed as % of the total number of minutes under observation.
(ii) *Preferability Index* : Is the number of minutes during which food of a certain type was eaten expressed as a number of minutes the type of food was available. Using these two indices and close examination of all browsing, grazing, preferential grazing, differential grazing and substantial grazing a seasonal diet list was prepared at 4 months interval.

However, while the diet chart simply lists food injested quantifications of relative amounts injested, are extremely difficult. Significant co-relations between preference ranking of a food and its nutrient or chemical content are almost impossible to evaluate since many plant components are reflections of each other e.g. plant parts high in protein are often low in fiber and high in digestible dry matter and energy. When nutrient constraints and secondary plant compounds are included in the foraging model, the complexity mushrooms because value of each food item is no longer independent of all others but rather each food item subsequently has an absolute value as well as a relative value that is dependent on the dieting composition of all other dietory components. For Rhinos exposed to many different foods the avoidance of toxins, while meeting the necessary requirements are accomplished by the foraging.

Increased Foraging Effort

Feeding and the search for food are the predominant activities of Rhinos, their activity patterns, daily energy expenditures and overall fitness reflects the costs and efficiencies with which food can be gathered. Rhino in Jaldapara exhibit the following behaviourial trends.

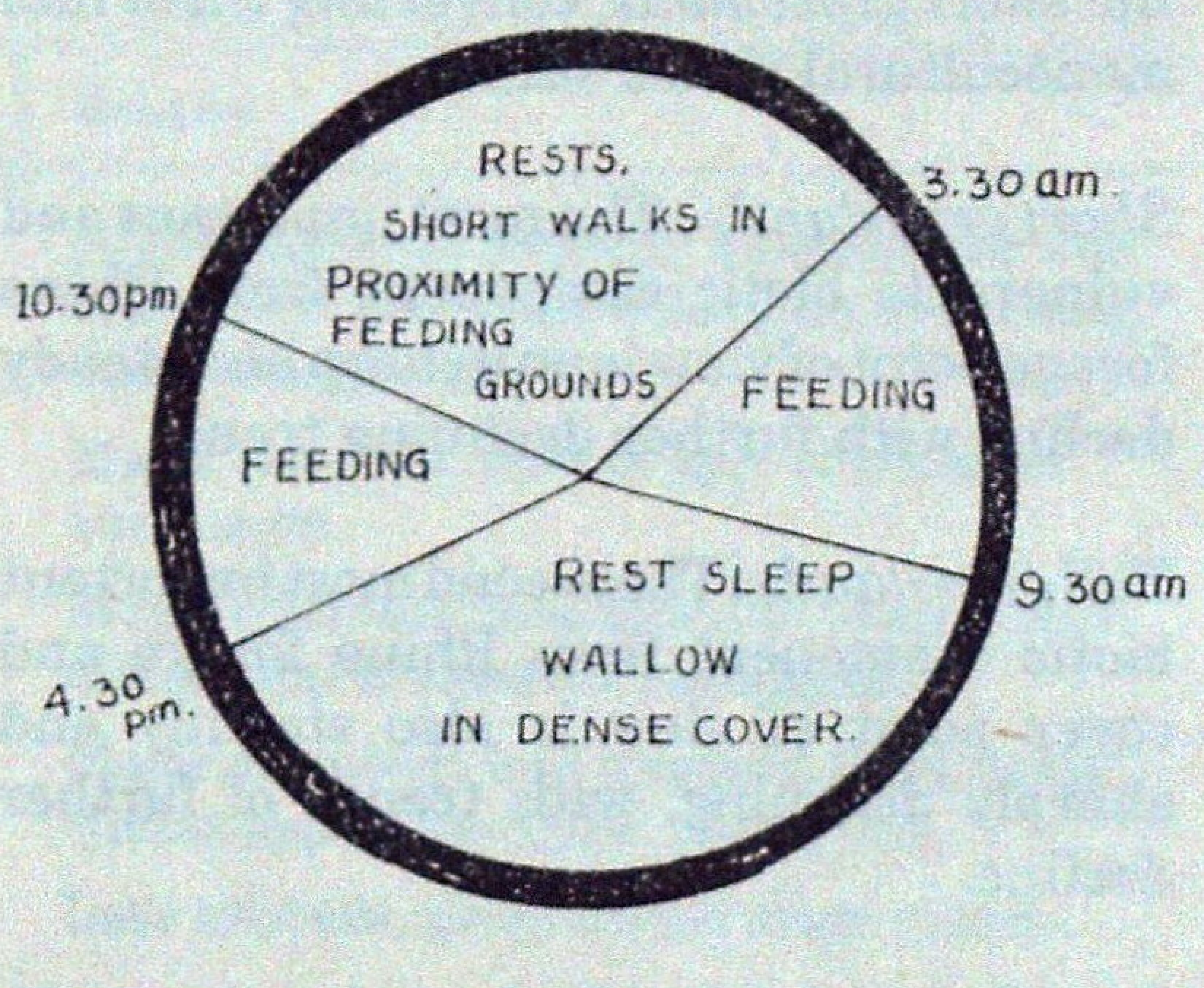
Increased foraging movements and clustering in particular pockets : Though Rhinos do not have fixed territoriality they do have very exacting and specified home ranges. The movements and activities of each animal is confined to an area only and even if dispersal takes place due to some biotic disturbance the animal ultimately comes back to the same area after the cause for dispersal removed or reduced.

Depending on the quantum of degradation of the habitat, the home ranges of Rhinos at Jaldapara are much larger than in comparison to other sanctuaries or natural parks. The defined home ranges for Rhinos in Jaldapara is depicted in (Fig. 4).

Whereas previously Rhinos were known to make a maximum movement of 2-3 km day with which sufficient food in quality and quantity was available, thereby minimizing time and energy expenditures for food gathering while maximizing digestible energy intake, an increased rate of movement ranging between 5 to 15 km per day is noticed in almost all Rhinos under observation since 1988. During these movements Rhinos have been observed to be constantly grazing or frequently browsing, according to the habitat, to finally reach some selected pocket having better quality and quantity of fodder.

These pockets are under heavy pressure of grazing as evident in at least two pockets.

Fig. 6



General Rhino time plot

One such area is Khejurbari at Jaldapara-3 Compartment and the other Khachubari at Sissamara adjoining the Malangi Watch Tower. In both of these pockets 9-10 Rhinos can be located within a radius of 2-3 km from any set point.

Thus as food density decreases, foraging effort increases. Rhinos alter foraging strategies by becoming less selective and choosing more favorable food patches in the total environment. Foraging efficiency ultimately decreases as the animal is forced to expend more time and energy in acquiring necessary food. A co-relation between forage consumption and foraging effort was attempted during study of these metabolic movements and feeding (Fig. 7).

Utilisation of Weeds by Rhinos

Rhinos are basically grazers as is also demonstrated in the construction of molars and pre-molars. The tall grasslands mainly plays the role of thermal, hiding, and fawning covers mostly and is utilized little

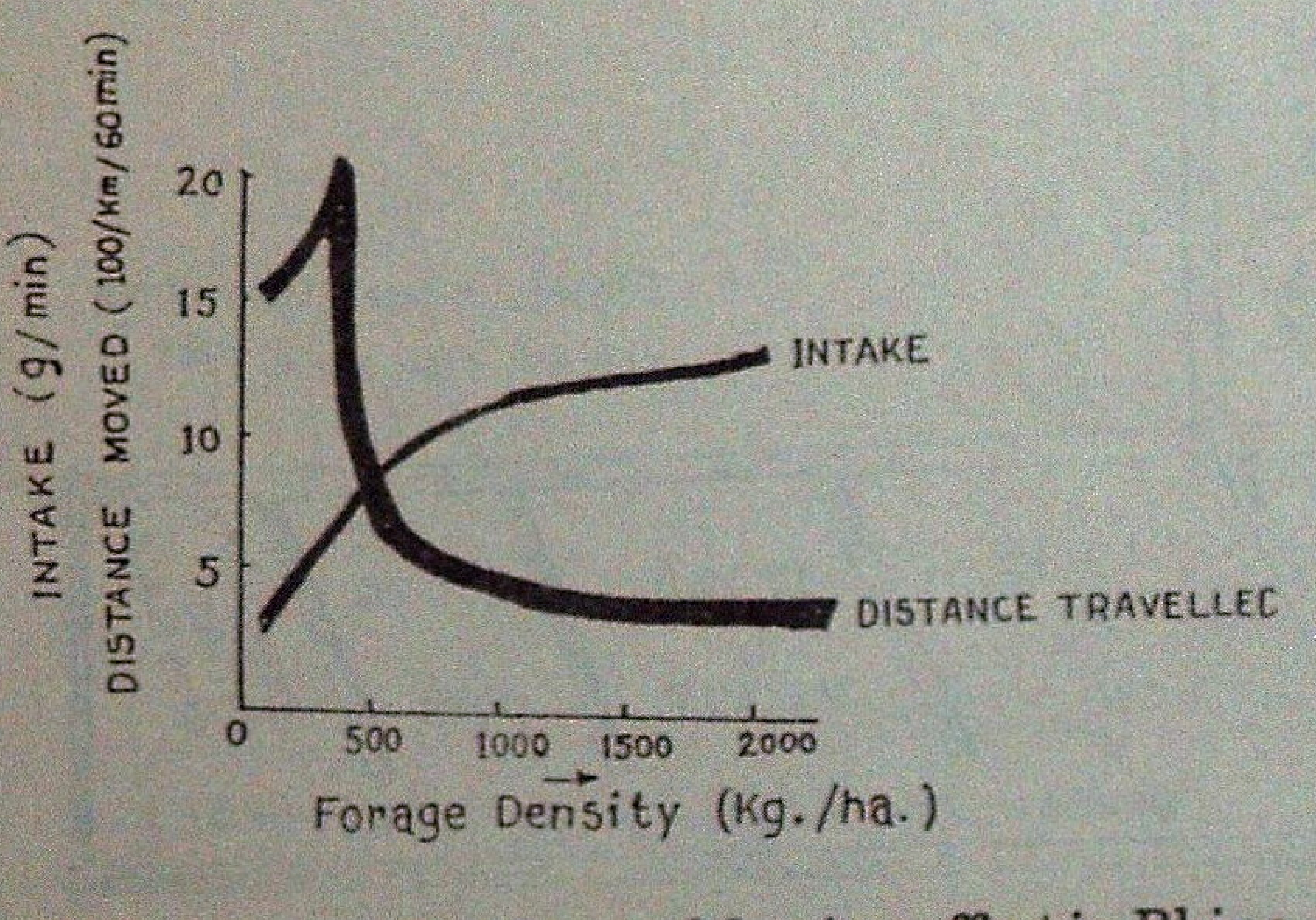
for feeding in Jaldapara. Large tracts of prime small grasslands have been covered by *Mikenia* species, and with this conversion of prime fodder areas, Rhinos are compelled to add considerable amounts of *Mikenia* spp. in their regular diet menu. During analysis and direct observation have shown about 30-35% of the food consists of *Mikenia*, in the younger Rhinos below 10 years and 15-20% in case of older Rhinos. The older age groups attempts to find as much grass forage before switching over to *Mikenia*. Invariably the tender growing shoots are taken.

Versatility

Due to a decreased level of food availability, the mode of behaviour of the Rhinos in Jaldapara is oriented in the following ways.

(1) Having the capacity to seek out and eat plants containing highly specific classes of nutrients and to balance nutrient ingestion relative to the spectra of nutrient requirements.
(2) Having to ingest a number of different sample foods over a short period of time and to indulge simultaneously in a continuous food sampling programme.
(3) Preferentially feeding on the foods with which they are familier and continuing to feed on them as long as possible.
(4) Preferring to feed on foods that contain only minor amounts of toxic secondary plant compounds.

Fig. 7



Forage consumption and forging effort in Rhino at Jaldapara during Metabolic movements

All these effects were observed in the analysis of habitat of Rhino on the utility pattern and based on this a Versatility Index Rating was made for Rhino and other associated species of Jaldapara Sanctuary, in that the number of plant communities and successional stages the species uses for feeding and reproduction.

The sensitively of each species to habitat change is directly related to versatility. The most versatile species are least sensitive to habitat manipulation and the least versatile are the most sensitive.

Versatility Score : (V) = (Cr + Sr) + (Cf + Sf)

Where Cr = Number of communities used by spp for reproduction.
Sr = Number of successional stages used for reproduction.
Cf = Number of communities used for feeding.
Sf = Number of successional stages used of feeding.

The versatility score was calculated by quantifying the land use pattern of each animal taken on account in the respective communities and successional stages. Pellet count, dung count and browsing and grazing signs were considered (Fig. 8).

In case of Rhino increase in the % versatility score from 1985 had been 42.1.

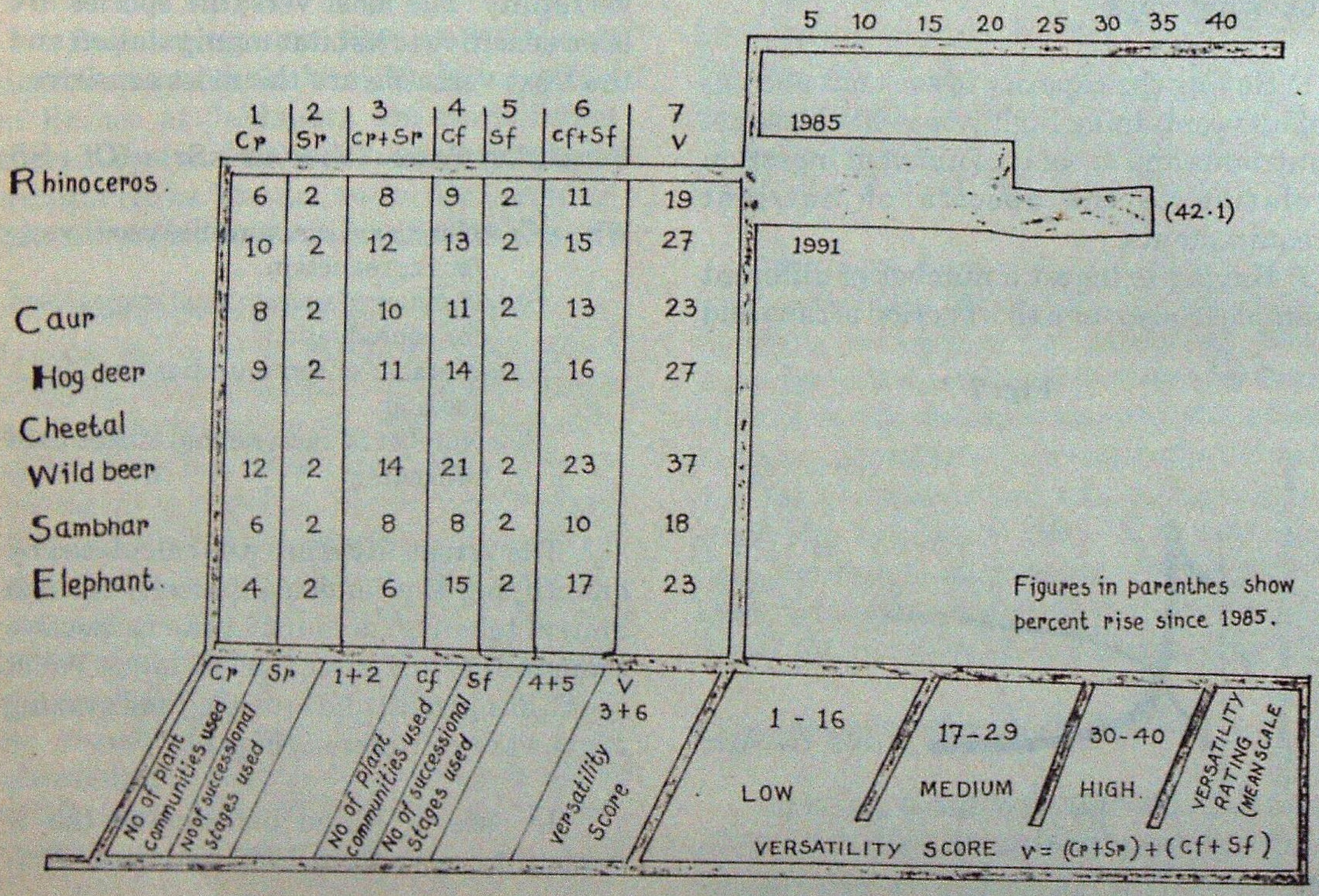
The Rhinos which had a medium

versatility rating till 1985 have now a high versatility rating. Where as the versatility rating in case of reproductive uses has been much lower in the scale, the rating in case of feeding has considerably increased. Basically grazers, Rhinos of Jaldapara has extensively taken up browsing on various shrub and tree species available as well as utilization of a large quantity of weeds like *Mikenia, Eupatorium, Clerodendron* etc. to cater to their energy requirements involved.

Extended Food Resource Utilisation

Evaluation of the animals versatility index rating shows a considerable % rise in the versatility rating (42.1%) form 1985 to 1991. Whereas till 1985 rating for Rhino at Jaldapara was in the medium category of versatility rating mean scale, in 1991 the rating has approached the high level of the scale. With the rating for the reproductive factor going down, this indicates, a much broader spectrum of plant species incorporated in the menu of the Rhino. Rhino has also extensively taken upto browsing from tree and scrubby growth, thereby increasing the intake of primary and secondary plant compounds, effects of which upon the gastrointestinal efficiency of the animal is yet to be quantified. However, the known effects of these

Fig. 8



	1 Cp	2 Sp	3 Cp+Sp	4 Cf	5 Sf	6 Cf+Sf	7 V
Rhinoceros	6	2	8	9	2	11	19
	10	2	12	13	2	15	27
Caur	8	2	10	11	2	13	23
Hog deer	9	2	11	14	2	16	27
Cheetal							
Wild beer	12	2	14	21	2	23	37
Sambhar	6	2	8	8	2	10	18
Elephant	4	2	6	15	2	17	23

Versatility Index Rating for Rhinos in Jaldapara Sanctuary

compounds have been corroborated with the Metabolic Feacal Nitrogen (MFN) analysis to make an attempt.

Primary plant compounds

(a) *Lignin* : A high molecular weight aromatic non-saccharide polymer that adds structural rigidity to the plant cell wall and is confined to higher plants, lignin concentration increase with advancing cellular maturity constituting 15-20% of the cell wall.

Since lignin degradation is dependent on oxidation, it is resistant to gastrointestinal fermentation.

(b) *Cutin, Suberin* : Closely related chemical compounds, cutin is the structural component of plant article and suberin occurs between cell wall and cytoplasm and is a major constituent of the bark. These as percentage dry matter are quantitatively insignificant in grass but constitutes 15% in browse cell walls. These physically block the digestibility of more readilly available cell wall polysaccharides.

(c) *Biogenic Silica* : Incorporated in plant tissue as distinct localized concretion, in medium and tall grasses (*Themeda phragmites* etc.), physically prevent their degradation.

Secondary plant compounds: Secondary plant compounds are an extremely diverse assemblage of anti harbivory chemicals ranging from feeding deterroney to antibiosis. Three most prevalent group of plant secondary compounds are soluble phenoloids, alkaloids and tereponoids.

(d) *Soluble Phenolics* : Soluble plant phonolics include flavonoids, isoflavonoids and hydrolysable and condensed tannins. The antiharbivory properties of these compounds are primarily due to their abilities to bind with proteins and other macromolecules thereby precipitating cellular proteins, in cultivating digestive enzymes, and possibly forming indigestible macromolecules with cell wall carbohydrates. Several isoflavonoids (e.g. coumestrol and genistein) are similar in configuration to estrogen and hence are capable of reducing or altering reproductive patterns in the animal.

Tannins occur in about 17% of the non-woody perennials, 14% of herbaceous perennials, 79% of deciduous woody perennials and 87% of evergreen woody perennials. Tennins are effective in their ability to precipitate proteins and preventing fungal, viral and bacterial attacks as well as harbivory by vertebrates.

(e) *Alkaloids* : Alkaloids are more common to plants growing in nitrogen rich environments (*Mikenia* spp.) and effects antiharbivory by incurred metabolic aberration when ingested. It also results in depletion of gastro intestinal enzymes and bacteria.

Through perrisodactyla (*Rhinoceros*) and other odd toed ungulates has developed an extensive lower tract fermentation (cecum) capable of digesting plant fiber as also the capability to conserve and synthesize microbial protein from non protein nitrogen, synthesize vitamins and detoxify many secondary plant compounds inferior to the normal site of host enzymatic digestion and absorption, constant intake of secondary plant toxins drastically reduces this capability due to depletion of enzymatic microbial population.

Conclusion

High levels of grains (cereals and pulses) required by *Rhinoceros* and is frequently obtained by increased incursion into agricultural fields is a gastro intestinal demand to replenish the reduced secretion of digestive enzymes and microbial population generated by high intake of secondary plant products, rather than casual intake of such crops for taste or smell. From the combination of various factors and their resultant effect on the ecostatus of *Rhinoceros*, leading to such depredations, it seems to be one way traffic, unless drastic well calculated measures are taken to remove the ecological imbalances and repair the habitat of the animal, so as to lessen its dependence on such forage high in secondary plant produce.

SUMMARY

Crop depredation by *Rhinoceros unicornis* differs in nature from other animals. Feeding habits of this Perrissodactyla with a capability of extensive lower tract fermentation, enables it to synthesize microbial protein from nonprotein nitrogen, synthesize vitamins and detoxify many secondary plant compounds replenishing of which is done by adding high levels of grains, to its fibrous diet, by "Crop Raiding".

जलदापाड़ा अभयारण्य के आस-पास *रहायनोसेरस युनिकार्निस*

(एक शृंग गेंडे) द्वारा फसल विनाशन - एक दिग्सूचक प्रवृति

दीपक के० घोष

सारांश

रायनोसेरस युनिकार्निस (एक शृंग गेंडे) द्वारा किया जाने वाले फसल विनाश अपनी प्रकृति में उन अन्य पशुओं द्वारा किए गये विनाश से भिन्न है। इस पोरिस्सोडैक्टाइल पशु की भोजन आदतें इसकी सघन अघोक्षेत्र किण्वन कर सकने की क्षमता से मिलकर इसे गैर-प्रोटीनी नाइट्रोजन से अणुजीवी प्रोटीन संश्लिष्ट करने, विटामिन संश्लिषण करनें, अन्य बहुत से गाँव पादप यौगिकों को पोषी विकरात्मक पाचन एवं अवचूषण की सामान्य स्थली से नीचे ही अविषाक्त बनाने में समर्थ बना देते हैं।

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MAN - WILDLIFE CONFLICT : CATTLE LIFTING AND HUMAN CASUALTIES IN KERALA

A. VEERAMANI, E.A. JAYSON AND P.S. EASA

Division of Wildlife Biology,
Kerala Forest Research Institute, Peechi, Thrissur (Kerala)

Introduction

The forests in Kerala are highly fragmented due to settlements and enclosures. Indiscriminate poaching of wild animals has come down since the enforcement of the Wildlife Protection Act (1972). Consequent to this, incidence of crop damage by wild animals has increased in Kerala (Veeramani and Jayson, 1995). Direct man-wildlife conflict include crop depredation, injuries, casualties, cattle lifting, and damage to buildings and other properties. All aspects of man-wildlife conflict except the crop damage is discussed here.

Cattle lifting by carnivores in North India has been reported by Banerjee (1994) and Thosre and Mahajan (1994). Dwivedi (1982) reported that on an average 618 heads of cattle were killed by Tigers annually within an area of 413 km^2 in Bandhavgarh National Park. Human deaths due to Elephants have been reported from parts of Central India by Datye (1993). According to Santiapillai and Jackson (1990), Elephants kill about 100 to 200 people, each year in India. Injury to human beings from wild animals are common as shown by Mohan (1994) and Tiwari (1994) in Garhwal area. Man-wildlife conflict in Karnataka, especially between Elephants and man, has been studied by Sukumar (1989) and Appayya (1992). No such study has been reported from Kerala. This paper assesses the extent of cattle lifting and human casualties due to wild animals in Kerala during the last decade.

Methods

Information on cattle lifting and human deaths for the period 1983-1993 due to wild animals were collected from the records of the Divisional Forest Offices and from discussions with the forest officials. The details gathered included animals involved in cattle lifting, human deaths, injury and damage to the property and details on compensation paid. Enquiries were also made with the settlers living in the areas adjoining forests to collect information on cattle lifting and human casualties in twenty randomly selected forest ranges.

Results

Cattle lifting : Cattle lifting was by Panther (*Panthera pardus*), Tiger (*Panthera tigris*) and Wild Dog (*Cuon alpinus*). Tiger was involved in twenty two attacks on Goats and twenty one cases of cattle lifting. Most of the incidences occurred when the cattle went for grazing in the forest areas during the day. Panther preyed upon Goat, Pig,

Table 1

Livestock killed by wild animals in Kerala during 1983 to 1993.

Predator	Goat	(%)	Pig	(%)	Cow	(%)	Domestic	
							Dog	(%)
Tiger	22	(43.1)	-	-	21	(70.1)	-	-
Panther	19	(37.3)	5	(100)	7	(23.3)	3	(100)
Wild Dog	10	(19.6)	-	-	-	-	-	-
Wild Boar	-	-	-	-	1	(3.3)	-	-
Elephant	-	-	-	-	1	(3.3)	-	-
Total	51		5		30		3	

(-) No cases reported

Cow, and Dog and nearly all the incidents tool place around the human habitations and majority of the attacks were at night (Table 1). Wild Dogs were involved in the attack on Goat, both around the human habitations and in the forest. Incidences of a Cow being killed by an Elephant and Wild Boar *(Sub scrofa)* were also reported during the period.

Compensation for cattle lifting : Wynaad Wildlife Sanctuary registered maximum cases of cattle lifting and the owners claimed an amount of Rs. 120,150 as compensation for the loss during the decade. Kerala Forest Department sanctioned an amount of Rs. 18,850 as compensation. Lowest amount was claimed in Mannarked and Idukki Divisions and no compensation was given in Idukki and Munnar Divisions. A total of Rs. 1,86,350 was claimed as compensation for cattle lifting from all over Kerala but the Forest Department released only Rs. 36,600 (Table 2).

Human attacks and Compensation : A total of 31 deaths, 64 injuries to human beings and two house damages were reported during the period. Elephants were involved in 30 human deaths, 27 due to herds and three due to solitary tuskers. One death was due to Gaur in Parambikulam Wildlife Sanctuary. The highest number of deaths (10) were reported in 1990 followed by 1993, 1992 and 1991. In all other years, only one case each has been reported (Fig. 1). The higher number of deaths reported to the Forest Department after 1990 may be due to an increase in compensation offered by the department in the year.

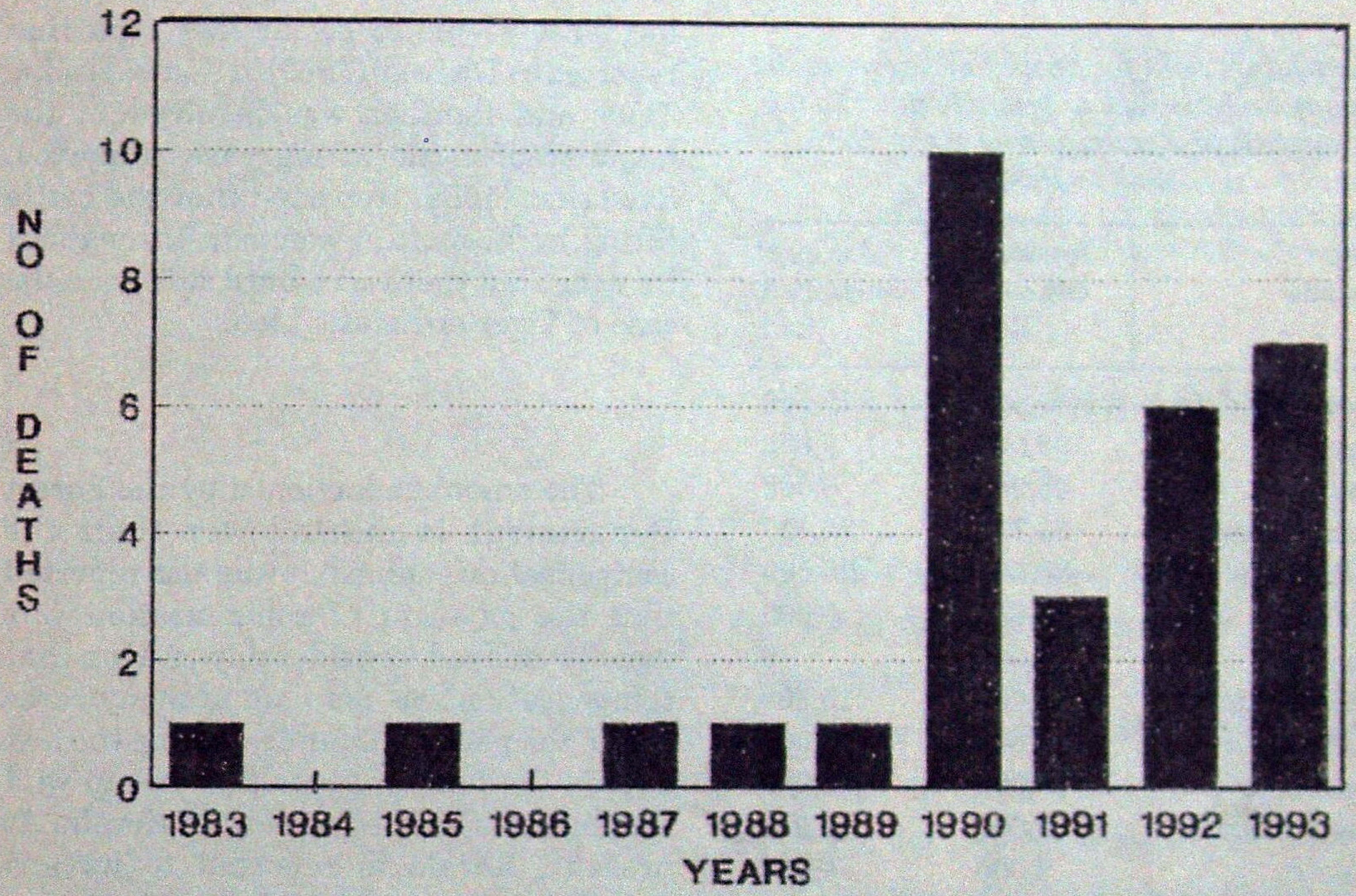
Injury to people by wild animals is normally reported from the forest fringes,

Table 2

Compensation paid for cattle lifting by wild animals in Kerala during the period 1983 to 1993.

Forest Divisions	Amount claimed (Rs.)	Amount sanctioned (Rs.)
Wynaad Wildlife	1,20,150	18,850
Kannur	18,700	6,850
Munnar	17,000	0
Periyar	12,500	3,000
Thrissur	10,000	4,900
Mannarkad	4,000	3,000
Idukki	4,000	0
Total	1,86,350	36,600

Fig. 1



Human deaths due to Wild Elephants in Kerala

Carnivores were highly involved in these types of conflict. There were 64 cases of injuries and 2 attacks on houses by wild animals. Out of these, Elephants were responsible for 32, Panther 14, Sloth Bear 8, Gaur 2, Tiger 2. House damages were all due to Elephants.

Compensation was claimed for all the wildlife attacks reported. Five thousand rupees was paid as compensation for a human death till the year 1989 and then it was increased to Rs. 10,000. Wynaad Wildlife Division registered the highest number of injury cases compared to other Divisions. The total amount claimed as compensation was Rs. 17,49,500 and the Forest Department sanctioned only Rs.1,25,150. In the North Wynaad and Vazhachal Divisions, there were no claims for compensation, but the Forest Department has paid some money to the victims. A total of Rs.20,64,900 was claimed as compensation in the whole of Kerala and an amount of only Rs.2,95,000 was sanctioned (Table 3).

Control measures : To prevent the wild animals from entering the human habitations, high voltage electric fencing, trenches, chemical and mechanical methods are being employed in Kerala. In Wynaad Wildlife Sanctuary, Kerala Forest Department has erected a series of electric fences to stop the Elephants from entering the crop fields and villages. Electric fences and trenches were effective in controlling the wild animals. Use of crackers, torches, shouting from machans etc. were the methods used to chase the animals from the

Table 3

Compensation paid for death and injury to the humans and damage to property due to wild animals in Kerala during the period 1983 to 1993.

Forest Divisions	Amount claimed (Rs.)	Amount sanctioned (Rs.)
Wynaad Wildlife	17,49,500	1,25,150
Munnar	96,000	5,000
Thrissur	45,000	6,000
Parambikulam	31,750	25,350
Idukki	30,500	25,500
Chalakudi	28,650	5,000
Kottayam	17,000	0
Nilambur North	16,000	15,800
Palakkad	10,000	10,000
Mannarkad	10,000	20,000
Nilambur South	9.000	1,900
Nemmara	9,000	6,500
Trivandrum Wildlife	5,500	36,000
Kannur	5,000	750
South Wynaad	2,000	750
North Wynaad	0	1,300
Vazhachal	0	10,000
Total	20,64,900	2,95,000

crop fields and villages. At some places, the villagers were using dogs to chase the wild animals, but occasionally elephants chased the dogs back into human habitation and in the process destroyed, the properties.

Discussions

Cattle lifting is reported from all the forest areas in Kerala, however, the incidence seems to be far less than that reported by Dwivedi (1982) in Central India. Tiger and Panther was involved in the majority of cattle lifting cases reported. Sawarkar (1986) reported that the cattle lifting by Leopard is common throughout its range but there is no hard data as in the case of Tiger or Asiatic Lion.

The amount sanctioned by the Forest Department is much lower than the compensation claimed. It was also reported that the payment of compensation was usually delayed, considerably or even that compensation was not paid in many cases due to the paucity of funds. During the last decade the human casualties due to wild Elephants is on the increase in Kerala. At present, Kerala is reported to have a population of about 4,300 Elephants (Anon., 1993). Deaths were more due to herds than solitary tuskers contradicting the general belief that tuskers are more aggressive. Field observation in some areas shows villagers entering the forest to collect NTFPs like reed, firewood, honey and medicinal plants were also killed. Similar observations have been reported from North Bengal (Dey, 1991) Electric fences using energizers, effective against Elephants, can be installed wherever the man-wildlife conflict is a serious problem. Proper education of the local settlers about the behaviour of animals will also reduce the conflict. Resettling of enclosures to outside areas may also solve the problem to a certain extent.

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We are grateful to Dr. S. Chand Basha, IFS Director, Kerala Forest Research Institute, Peechi for his interest in this study. Shri. P.K. Surendranathan Asari, IFS. C.C.F.(Wildlife) has rendered all the help for the study. The study was financed by the Wildlife Wing of the Kerala Forest Department. Dr. Ajith Kumar, SACON, Coimbatore has suggested many improvements to an earlier draft of this paper.

SUMMARY

Information on man-wildlife conflicts in Kerala during the period 1983-93 were collected from the office records of the Divisional Forest Offices and by Visiting areas from where man-wildlife conflicts were reported. Cattle lifting was mainly due to Panther (*Panthera pardus*) Tiger (*Panthera tigris*) and Wild Dog (*Cuon alpinus*). Eighty nine cattle lifting cases were reported during the period. Thirty one human deaths and 64 injury cases were also reported, mostly due to Elephants. Out of the total compensation claimed for cattle lifting only 20% was disbursed and only 14% were disbursed for human casualties. Electric fences using energizers may solve the problem temporarily. Resettling of villagers from inside the forest areas is also advisable.

मानव और वन्य प्रणियों का संघर्ष - केरल में गाय बैल उठाना तथा मानव को मारना

ए० वीरमणी, ई०ए० जयसन व पी०एस० एआसा

सारांश

केरल में 1983-93 की अवधि के दौरान चले मानव-वन्य प्राणि संघर्ष की जानकारी वन मण्डल अधिकारियों के कार्यालयों के कागज-पत्रों तथा उन क्षेत्रों में जाकर, जहाँ मानव-वन्य प्राणि संघर्ष होने की सूचना मिली थी, इकट्ठे किए गए हैं । गाय बैलों को उठाने का काम प्रधानतः तेन्दुओं (*पैन्थेरा पाड्रस*), बाघ (*पैन्थरा टाइग्रिस*) और जंगली कुत्तों (*कुवोन एल्पाइनस*) ने किया है । इस अवधि में माय-बैल उठाने की 89 वारदात सूचित हुई व 31 मानव हत्याएं तथा 64 क्षति पहँचाने की घटनाएँ, मुख्यतः हाथियों द्वारा, सूचित की गई । पशुओं को उठाने के लिए प्रस्तुत किये गए दावों में से मांगे कुल हरजाने का केवल 20% भुगताया गया तथा कैंवल 14% हरजाना मानवों के मारे जाने का दिया गया । तार बाढ़ में बिजली दौड़ा कर समस्या अस्थाई तौर पर सुलझ सकती है । वन क्षेत्रों के अन्दर से ग्रामवासीयों को निकालकर उन्हें अन्यत्र बसाना भी वांछनीय रहेगा ।

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KEYS FOR IDENTIFICATION OF PLANT REMAINS IN FAECAL MATTER OF UNGULATES

R.D. SHARMA*

Introduction

The keys for identification of plant remains in the faecal matter of ungulates have been prepared with reference to Chila Sanctuary (now in Rajaji National Park), situated at a distance of about 8 km, South and South-East of Hardwar in U.P., the study area (248.932 km^2 in area). Various species of wild ungulates found in the study area are Chital, Sambar, Barking Deer, Nilgai and Goral. These wild ungulates feed upon various plant parts present within their reach. Besides, following natural and biotic influence in the area bring down various plant materials which are otherwise unavailable and make them available within the approach of these animals.

(i) Natural dropping of deciduous leaves and mature fruits of trees.

(ii) Lopping (by Gujjars) of fodder tree species.

(iii) Elephant damage to trees belonging to various species, most important of which is *Mallotus philippensis*. Extent of damage varies from merely breaking of branches to uprooting of trees.

Studies in plant anatomy have taken long strides following the development of sophisticated microscopic techniques but much anatomical studies to put into use for identification of plant remains in animal droppings have not been done. Such a work in India is of recent origin. A beginning in this direction has been made by Satakopan (1972) to assist the Bombay Natural History Society in their long term project on ecological research in Gir Forest in collaboration with Smithsonian Institute and Yale University School of Forestry.

In the present work the methodology adopted and the criteria used in the preparation of keys are the same as used by Satakopan (1972). But the present work differs from that of her in the basis on which keys have been built. She built her keys on the basis of plant debris seen in the pellet samples, whereas in this work after having selected the workable criteria, the keys have been finally based on the study of are vegetative powders using those criteria, although the characterics as they are seen in the pellet samples have been simultaneously compared with those seen in the pure vegetative powders in most of the cases.

The studies presented in this work will also improve the knowledge of all those interested in the domain of plant Anatomy, besides serving the purpose for which they have been intended.

Materials

The materials were collected and preserved as follows from the study area in

* Superintendent, Pench Sanctuary, Seoni (Madya Pradesh)

the months of November and December.

(1) About 70 species of plants consisting of twigs, leaves, flowers and fruits.

As far as possible, the same plant material possessing different parts such as twigs, leaves, flowers fruits was collected. In some cases detached leaves and fruits were also collected.

Twigs, leaves, flowers and small fruits were pressed, dried and stored in the form of herbarium for further study. Detached leaves were also pressed and mounted on herbarium sheets. Detached fruits and larger fruits were separately dried and kept.

(2) 35 samples of relatively fresh pellets of various ungulate species met within the study area. The collection of the pellet samples and plant material were done simultaneously.

The pellet samples were thoroughly dried for five days. Every day the samples were put in sunlight at 0900 hrs and were transferred to shade at 1600 hrs. One pellet then the samples were kept in polythene bags.

Methods

The methods have been mainly based on those adopted by Satakopan (1972) with minor procedural modifications.

(1) Preparation of slides from pellets, of various ungulate species, collected from study area.

These slides were prepared by processing each sample as follows :

(a) *Starting sample* : Each original sample contained more than 5 butless than 25 pellets. This sample was put in a dry tray, rolled and tossed in all directions till the pellets were thoroughly mixed; the sample was mixed and individual pellets were picked up from various portions till about six or eight pellets are obtained.

(b) *Preparation offinal sample* : The starting sample was put in a mortar and ground loosely so that pellets discrete particles in a coarse powder form. The grinding was done to separate the agglomerates into single particles. The powder was then sieved through an ordinary sieve. The bigger particles that could not pass through the sieve were kept separately and finer particles were first taken for further processing. Those finer particles were further divided into four parts, only one of these parts was taken to constitute final sample; other three part were kept as reserve. Few pieces of bigger particles were taken and these formed a different final sample for the same pellet sample and the rest of these bigger particles were kept as reserve.

(c) *Further processing of final sample and preparation of slides* : The final sample were boiled in about 2 or 3 ml of chloral hydrate aqueous solution (50 g in ml) taken in a test tube using spirit lamp. If the chloral hydrate was too dark or coloured blackish, the powder was allowed to settle, supernatant poured off and fresh quantity of chloral hydrate was added and boiling repeated. In some case third boiling was found to be necessary. When the powder appeared to the eye as fairly clarified, the cooking was considered sufficient. After cooling distilled was added and the material was shaken thoroughly, allowed to settle and supernatant poured off. This washing was repeated till all the chloral hydrate was

washed off. The powder was than dehydrated with alcohol washings. These washings were repeated two or three times to remove all water. Thereafter, the powder was passed through grades of alcohol:Xylol mixtures with the latter in increasing proportion, in successive mixtures (Alcohol : Xylol 3 : 1, 1 : 1, 1 : 3) and finally in pure Xylol. The mounting was done in glycerine and thus temporary slides were prepared for study.

(2) *Preparation of slides from known plant materials* : In most of the cases permanent slides were prepared for study and future references from known plant materials. In some cases temporary slides were prepared for study. The slides were prepared as under:

A few bits of leaves, twigs, flowers and fruits and seeds were taken from each plant species. Every plant part was separately processed as under and a separate slide was prepared for each.

The bits of leaves and twigs were shredded coarsely and placed in a test tube. 2 or 3 ml of chloral hydrate aqueous solution prepared as above was added to the material in the test tube. The tube was heated on a spirit lamp, till boiling. Highly coloured materials took a second boiling with fresh quantities of chloral hydrate. The tube was allowed to cool, the liquid drained off, washed repeatedly in distilled water, dehydrated in alcohol, passed through grades of alcohol; xylol mixtures with latter in increasing proportion, in successive mixtures, (Alcohol : Xylol, 3 : 1, 1 : 1, 1 : 3) and finally, in pure xylol. The mounting was done in Canada balsam for preparing permanent slides. Some temporary slides were prepared using glycerine.

The bits of flowers, fruits and seeds were also processed in the same manner as above but 5% solution of KOH, instead of chloral hydrate aqueous solution was used in the initial treatment.

Preparation of Keys

Criteria used : To arrive at a basis on which to develop a key for the purpose, mounts prepared by author from pellets were studied in detail and characteristics so observed were compared with the characteristics seen in the slides prepared from pure vegetative tissue. This study which constituted the most important and most difficult part of the job, revealed that the characteristics which can be used as criteria for developing such keys must fulfill the following three requirements :

(i) The characteristic must come out with the faeces undigested, in the least altered or unaltered condition.

(ii) It should be constantly found in the genus or species concerned.

(iii) The characteristic must be specific to the species or at least to genus. These requirements have finally been fulfilled by structure, dimension and abundance of trichomes on which the main key has been based. For cross checking of the main key, supplementary keys have been based on certain other features of these plants that are present in the faecal samples. These features are crystals, epidermal cell characteristics, stomatal characteristics, sclereids, structural peculiarities in fruit and seed tissues.

Other microscopic characteristics of plant that are normally present in pure vegetative powders and serve for diagnosis are fibres, quantitative indices like number

of ray cell tiers, palisade ratio, veinlets number, epidermal cells per unit area, stomatal number etc. but these characters provide very little assistance in identifying the plant remains in pellets as they are unable to fulfill on or the other of three requirements mentioned above. Tissues and tissue systems loose their identity due to their disintegration and for the same reasons, they also do not occupy important position for their use in the preparation of keys.

Several species of grasses met with in the area were studied in detail and compared with plant remains in the pellets but no character has been found to fulfill all the three requirements as above. But the grass as a group can be identified very easily by structure of trichome or bits of leaf epidermis. Therefore no attempt has been made to prepare the key for the identification of grass species. The only attempt which has been made is to distinguish grass groups from Dicots.

The Keys

The various keys which have been prepared are described as under :

1. Key based on intact trichomes

Trichomes unbranched :

I A - Trichomes unicellular

(1) Trichomes curved, short, tip blunt, lumen narrow, but broader at the base, like an inverted funnel, a round crystolith sometimes present at the base of the trichome. Length varies from 140-385 microns, maximum width - 50 microns.

........*Diospyros montana*

(2) Trichomes small, length 420-630 microns, maximum width 20 microns, curved, thick walled, narrow lumen, absent in older parts, present only on very young buds.

..........*Lagerstroemia parviflora*

(3) Over 510 microns in length, conical partition at the base. Very thick walled and very narrow lumen, sometimes absent; gradually tapering towards the tip, often curved.

..........*Anogeissus latifolia*

(4) Length 490-700 microns, maximum width 14 microns, thick walled, lumen narrow, but present upto the tip, present on veins and veinlets, base rounded.

..........*Milletia auriculata*

(5) Length 105-525 microns, width upto 30 microns, occurs singly, more abundant on pedicle and midrib, tip acute, lumen not present throughout the length of trichome, present only in proximal half or slightly more than half length. Lumen as broad as the cell wall whenever present.

...........*Lantana camera*

(6) Dimorphic, micro and macro types : (a) Micro types 35-140 microns, width upto 7 microns, always in congested groups. Sometimes curved in a hooklike manner, abundant, hyaline, thick walled narrow lumen. (b) Macrotypes - 150-280 microns, width upto 20 microns, spinous, sparse, thick walled, narrow lumen.

.... *Mallotus philippensis*

(7) Length 150-670 microns, maximum width 42 microns fusiform, thin walled, hyaline, abundant on young shoots, sparse on leaves.

...... *Indigofera onneaphylla*

(8) Length 105-840 microns, max. width 21 microns, abundant on leaf margin and on veins, base clavate, lumen narrow about 1/3 of the total width.

.... *Desmodium pulchellum*

(9) Length 140-350 microns, width upto 14 microns, very rare on leaves, cylinder, tip blunt; lumen narrow filled with fat blackish substance, appears as a black line along the length of trichome.

.... *Flemingia chappar*

(10) Length 70-560 microns, max. width 21 microns, abundant on leaf, generally curved or whipy, cell wall thin, lumen broad, tip acute.

.... *Flacourtia cataphracta*

(11) Length varies upto 770 microns, max. width 14 microns, ephemeral, abundant on flowers, young shoots and petiole, generally absent on mature leaves, very very rare on young leaves, lumen vary narrow, ascaroid.

.... *Shorea robusta*

(12) Length upto 160 microns, max. width 14 microns, tip obtuse, smooth, thin walled, broad lumen, vary rare.

.... *Aegle marmelos*

(13) Length 140-420 microns, max. width 14 microns, thin walled, lumen broad, tip pointed, abundant on petiole, straight.

...... *Delbergia sissoo*

(14) Length 280-770 microns max. width 56 microns, thin walled, broad, lumen, tip acute.

...... *Polygonum* spp.

(15) Length 49-175 microns, max. width 10 microns, thin walled, lumen broad, blunt tip, rodlike.

.... *Terminalia chebula*

(16) Length 500 microns or less max. width 25 microns, lumen as broad as cell wall but broader than cell wall at the base, slightly warty cuticle.

.... *Acacia* spp.

(17) Length upto 300 microns, stout, very thick, striated lignified walls with yellowish tinge, spinous or prickly.

.... Any grass

(18) Length upto 200 microns, max. width 10 microns, rounded base blunt tip, thin cell wall broad lumen.

.... *Schleichera oleosa*

I B - Trichomes Multicellular

I B 1. *Uniseriate, Pseudo-septate* :

(1) Length upto 490 microns, max. width 35 microns, always in conjested groups on the epidermal layer, 1-3 septate cell wall not very thick, lumen broader than cell wall upto tip, often curved.

...... *Woodfordia fruticosa*

(2) Upto over 700 microns, highly curved to coiled, spiral, whipy but never straight, septa more than two.

.... *Zizyphus mauritiana*

(3) Length 84 to 740 microns, max. width 28 microns, 3 to many celled, gradually tapering towards the tip, tip acute, smooth, lumen broad, cell wall thin.

.... *Zizyphus oenoplia*

(4) Length 70 to 770 microns, max. width (near middle part) 30 microns, fusiform, 3-septate, tip often curved, broad lumen, cell wall thin, absent on leaves, present on young shoots.

.... *Ichnocarpus* spp.

(5) Length 105-175 microns, max. width 14 microns, very rare, straight, spinous, many septate, lumen narrow, cell wall thick.
...... *Holarrhena antidysenterica*

(6) Length 70-320 microns, max. width 56 microns, two-nine celled, thick walled, lumen 1/3 of total width, spinous, wall warty, lowest cell with rounded base, not abundant nor very rare.
.... *Rungia repens*

(7) Length 350-420 microns, max. width 35 microns, 2-7 celled, lumen broad, progressive increase in cell-length from base to tip, tip acute.
.... *Ageratum conyzoides*

(8) Length 70-224 microns, max. width 21 microns, 2-5 septate, commonly three septate, thin walled, sometimes curved, sometimes with transverse striations.
.... *Bridelia retusa*

(9) Length 35-235 microns, max. width 14 microns, upto 3 - septate, tip blunt, lumen narrow, cell wall thin, often bow shaped, absent on leaves abundant on young shoots.
.... *Putranjiva roxburghii*

(10) Length 560-700 microns, max. width 43 microns, more than two-celled, lumen broad, cell wall thin. 2-3 proximal cells form bottle shaped structure, distal part gradually tapering to a pointed tip.
.... *Adina cordifolia*

(11) Length 56-560 microns, max. width 21 microns fusiform, sometimes spirally twisted, rarely with constrictions and swellings alternately along the longitudinal plane, lumen broad, thin walled, slender.
.... *Albizia procera*

(12) Length 56-70 microns, maximum width 35 microns, not very abundant on leaf, 2-5 septate, almost of the same width-along the whole length except near the tip where it gets narrowed down to a pointed tip, cell wall thin, broad lumen.
.... *Cassia tora.*

(13) Length 70-210 microns, max. width 14 microns, 3-celled, two basal cells almost rectangular and terminal cell is triangular.
.... *Limonia crenulata*

(14) Length 140-280 microns, max. width 21 microns, 2-3 celled very rare on leaves, tusk like, lumen broad cell wall thin.
.... *Murraya paniculata*

(15) Length 300 microns or less max. width upto 25 microns generally 2- septate, cuticle warty, lumen broader than wall, tips blunt, sometimes rounded.
.... *Bauhinia* Spp.

I B 2. *Uniseriate, true - septate.*

IB2 (a) Two celled :

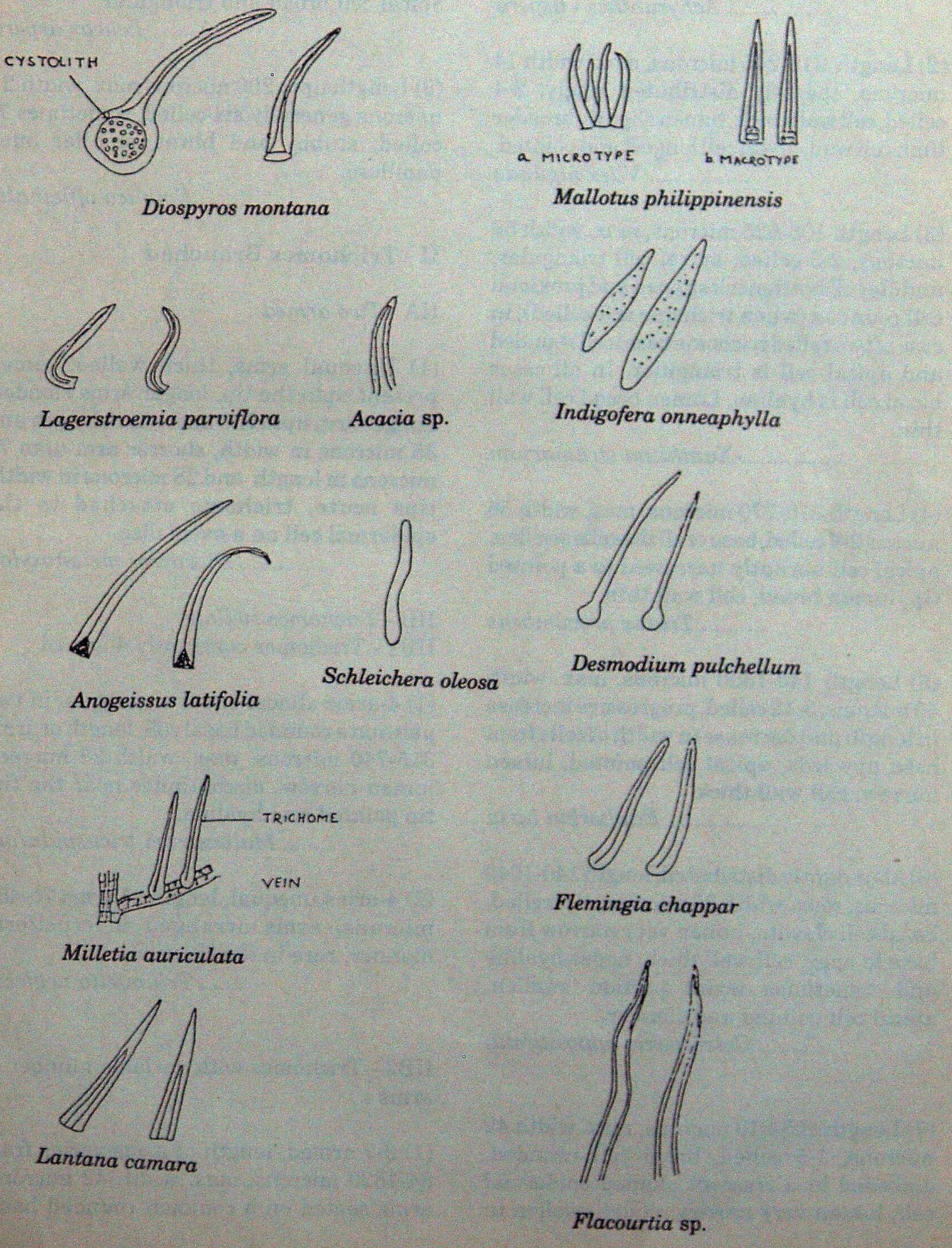
(1) Length upto 175 microns, very rare max. width 14 microns, 2 celled, thin walled lumen broad, proximal cell smaller about 1/3 of entire length distal cell longer narrow and triangular.
.... *Adhatoda vasica*

(2) Length over 500 microns, width 21 microns, smaller and broader basal cell and longer apical cell acute tip.
...... *Terminalia bellerica*

IB2 (b) More than two-celled :

(1) Length 154-525 microns, max. width 56 microns, 3-celled, basal cell smallest, node between middle and distal cell swollen, distal cell with closely serrated cell wall, tip acute,

Trichomes of Different Plant Species



lumen broad, cell wall thin.

.... *Achyranthes - aspera*

(2) Length 210-245 microns, max. width 14 microns, sparsely distributed singly, 2-4 celled, cell wall thick, lumen slightly broader than cell wall, distal cell longest and pointed.

.... *Vitex nigundo*

(3) Length 105-525 microns, max. width 56 microns, 2-3 celled, apical cell triangular, middle cell bottleneck shaped and proximal cell rounded (when trichome is 3-celled), in case of two celled trichome basal cell rounded and apical cell is triangular. In all cases basal cell is hyaline. Lumen broad cell wall thin.

.... *Xanthium strumarium*

(4) Length 210-770 microns, max. width 56 micros, 2-4 celled, base of all the cells swollen, apical cell abruptly narrowed to a pointed tip, lumen broad, cell wall thin.

.... *Tridax procumbens*

(5) Length 140-1300 microns, max. width 49 microns, 3-12 celled, progressive increase in length and decrease in width of cells from base upwards, apical cell pointed, lumen narrow, cell wall thick.

.... *Euphorbia hirta*

(6) Abundantly distributed, length 140-1540 microns, max. width 35 microns, 2-9 celled, basal cell clavate, lumen very narrow from base to apex, cell well thick, nodes hyaline and sometimes nodal portion swollen, apical cell pointed and slender.

.... *Colebrookia oppositifolia*

(7) Length 105-910 microns, max. width 42 microns, 1-5 celled, basal cell rounded, embeded in a crescent shaped epidermal cell, lumen very narrow, nodes swollen in older trichomes, cell wall hyaline and thick. apical cell broad and triangular.

.... *Leucas aspera*

(8) Length upto 200 microns max. width 21 microns generally six celled, sometimes 7-celled, stubby and blunt, smaller ones papillose.

.... *Emblica officinalis*

II - Trichomes Branched

IIA - *Two armed* :

(1) Unequal arms, thick walled, lumen present upto the tip, longer arms slender. Longer arm upto 630 microns in length and 35 microns in width, shorter arm upto 70 microns in length and 28 microns in width, tips acute, trichome attached to the epidermal cell on a ovoid disc.

.... *Diospyros melanoxylon*

IIB - *Trichomes stellate*

IIB1 - Trichomes constantly 4 armed :

(1) 4-arms almost equal or unequal in two pairs on a rounded basal cell, length of arms 315-740 microns, max. width 28 microns lumen narrow, discontinues near the tip, tip pointed and hyaline.

.... *Malvastrum tricuspidatum*

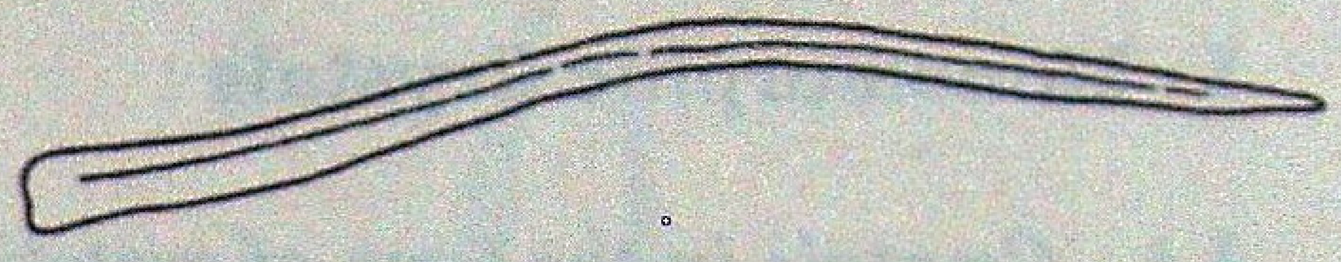
(2) 4-arms unequal, length of arms 70-450 microns, arms arranged in cruciform manner, rare in distribution.

.... *Triumfetta neglecta*

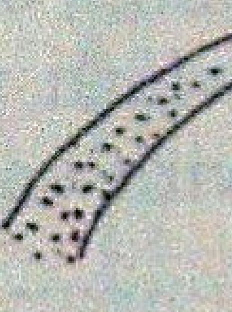
IIB2 - Trichomes with variable number of arms :

(1) 3-7 armed, length of arms varies from 84-1820 microns, max. width 42 microns, arms seated on a common rounded basal

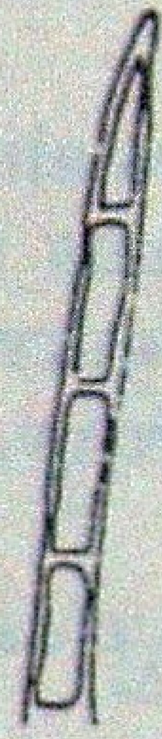
Trichomes of Different Plant Species



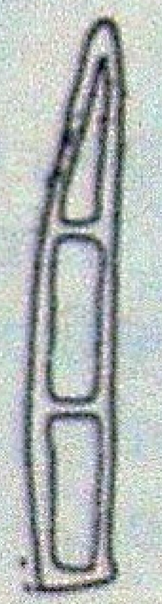
Shorea robusta



Aegle marmelos

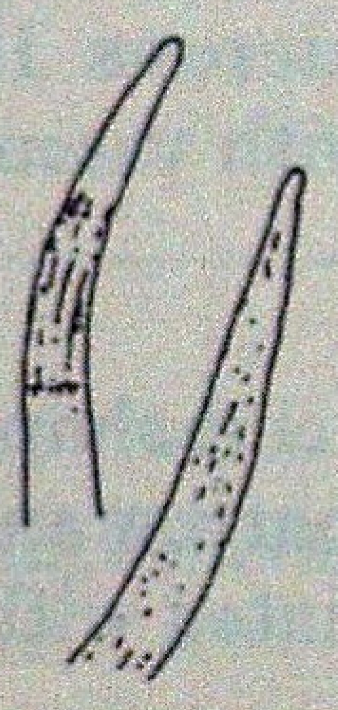


Cassia tora



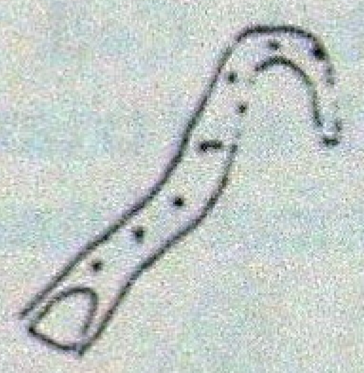
Limonea crenulata

Dalbergia sissoo

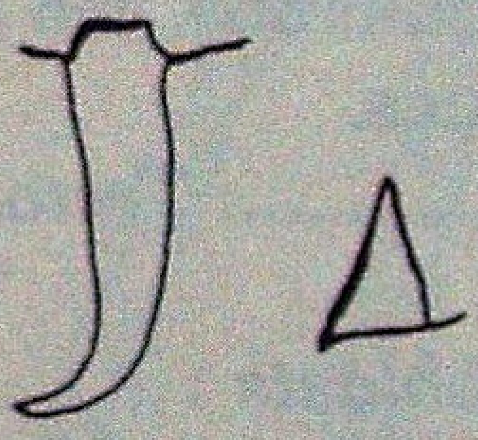


Murraya paniculata

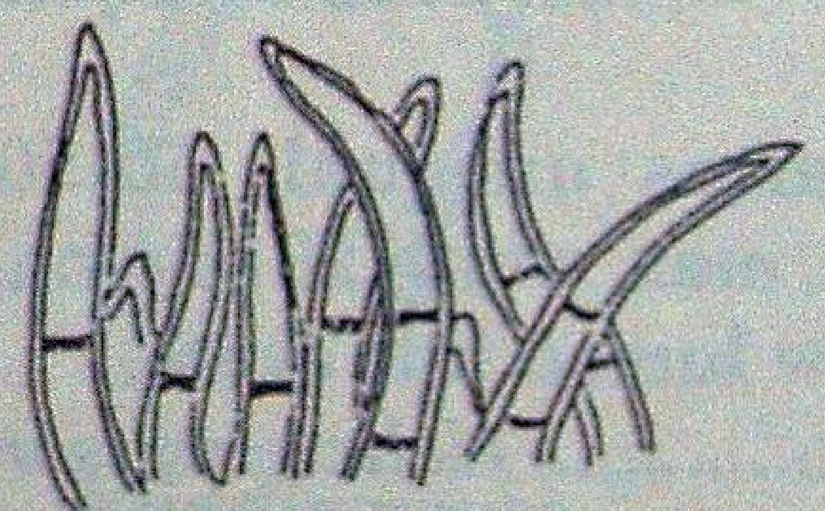
Terminalia chebula



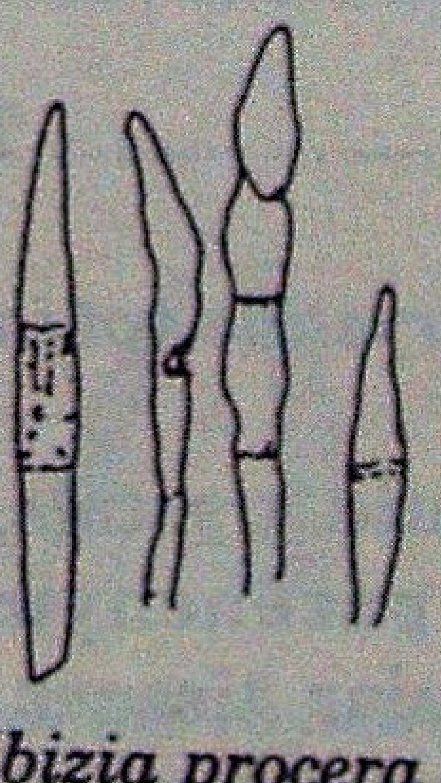
Bauhinia spp.



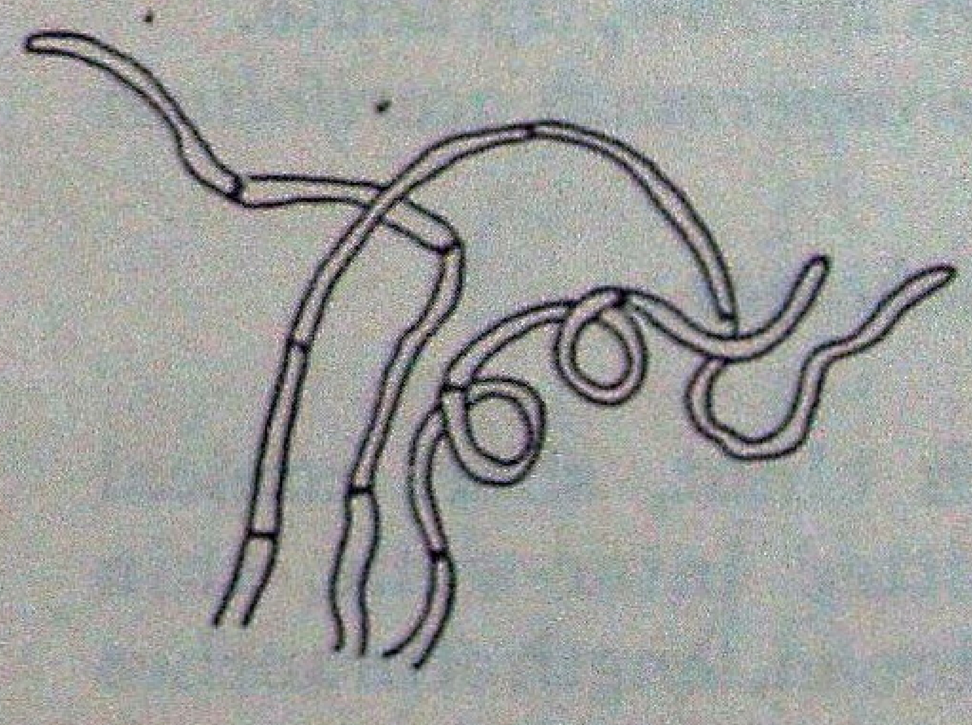
Grass



Woodfordia fruticosa



Albizia procera



Zizyphus mauritiana

cell. Sometimes longer arms are whipy, cell wall thin, lumen broad tip pointed, arms divergently oriented from the foot.
..... *Clerodendron infortunatum*

(2) 4-7 armed, unequal, sometimes almost equal arms arising from a bulbous foot. Length of arms varies from 70-980 microns, max. width 28 microns, lumen narrow, cell wall thick, tip pointed.
.... *Grewia elastica*

(3) 3-6 armed, of variable length from 105-1120 microns, max. width 56 microns seated on a rounded foot. Cell wall thick, lumen 1/3 of total width and triangular at the base, rare on leaves most abundant on fruit wall, tips blunt.
.... *Abutilon indicum*

(4) 2-3 armed, arms unequal, abundant on young fruits and flowers, rare on leaves, ephemeral, arms 140-350 microns, in length, width upto 35 microns arms, spinous with narrow lumen which ends 15-20 microns below the tip.
.... *Sida cordifolia*

(5) 6-8 armed, arms unequal, 50-500 microns, in length, max. width 28 microns, thick walls, narrow lumen tips acute.
.... *Helicteres isora*

(6) 5-11 armed, length of arms varies upto 400 microns, lumen narrow, tip acute.
.... *Pterospermum acerifolium*

IIC - *Dendritic Trichomes* :

(1) Dentritic with blunt, short conical branches with pitted inter-walls, thin walled, and lumen broad, length of branches 35-280 microns and width 28-30 microns.
.... *Tectona grandis*

2. Key based on Crystals

I - Monomorphic Crystals :

I A - *Crystals in the form of cystoliths* :

(1) Cystoliths uniformally distributed throughout the lamina, ovoid, length upto 175 microns and width upto 14 microns. Never associated with vascular tissues.
.... *Adhatoda vasica*

(2) Cystoliths sometimes at the base of trichomes, surrounded by smaller epidermal cells cystolith rounded, or almost rounded. Upto 94 microns in diameter. Never associated with vascular tissues.
.... *Diospyros montana*

(3) Cystolith club shaped, present in cortical region with narrow and near the epidermis. Never associated with vascular tissues.
.... *Rungia repens*

(4) Cystolith in lamina, very often at the base of the trichomes; epidermal cells walls thick at these places, round in shape, diameter upto 70 microns. No association with vascular tissues.
.... *Tectona grandis*

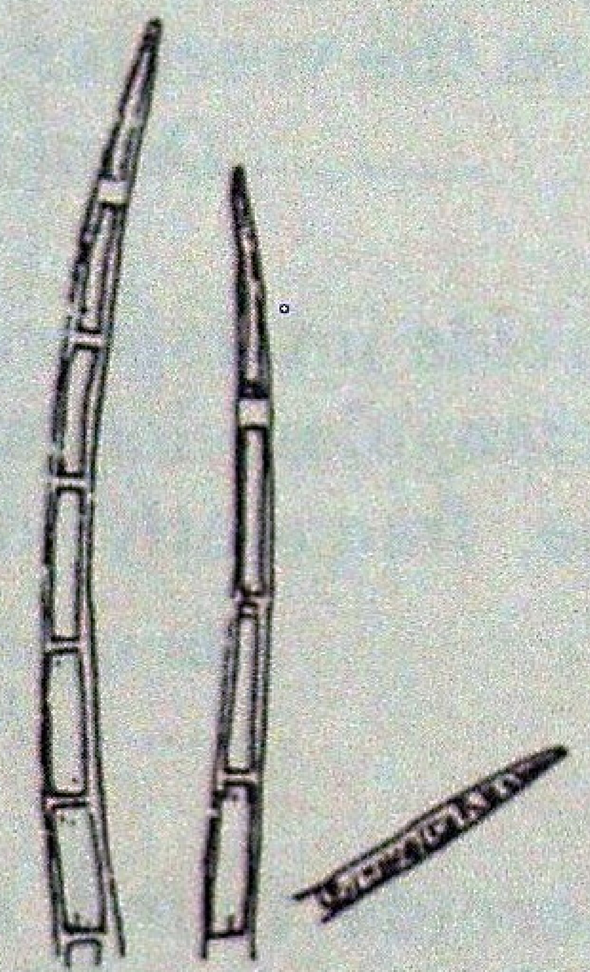
IB - *Crystal in idioblasts* :

(1) Crystals in rosettes measuring upto 85 microns in diameter. Not associated with vascular tissues.
.... *Terminalias*

IC - *No cystoliths, crystals not in idioblasts* :

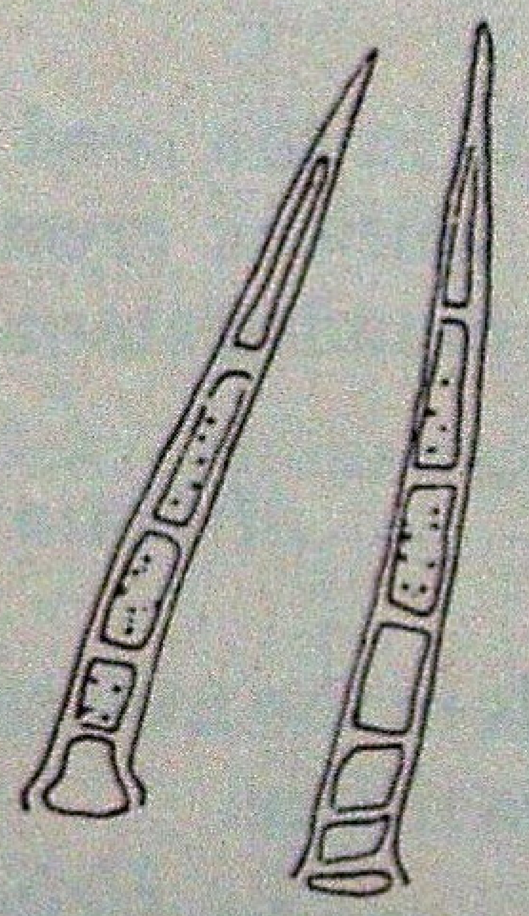
1 - Single prismatic crystals, abundant, positioned in parenchyma sheath surrounding vascular tissues and inside vascular fibres. Invariably associated with

Trichomes of Different Plant Species

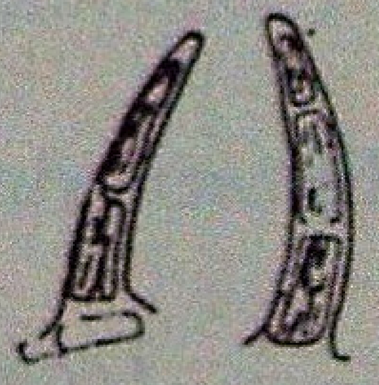


Zizyphus oenoplia

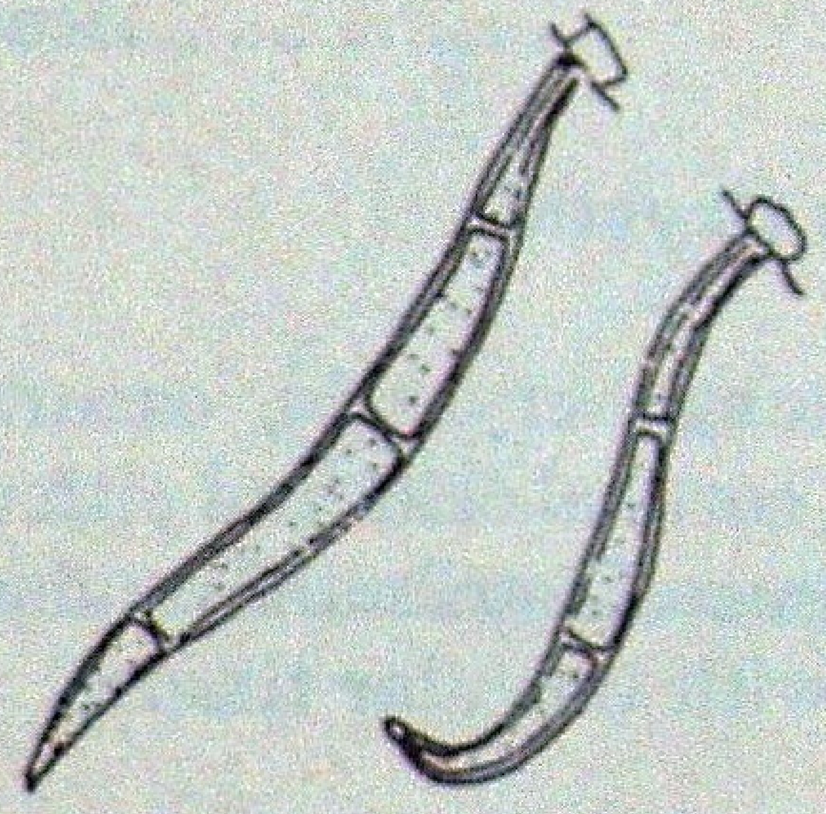
Hollarhena antidysenterica



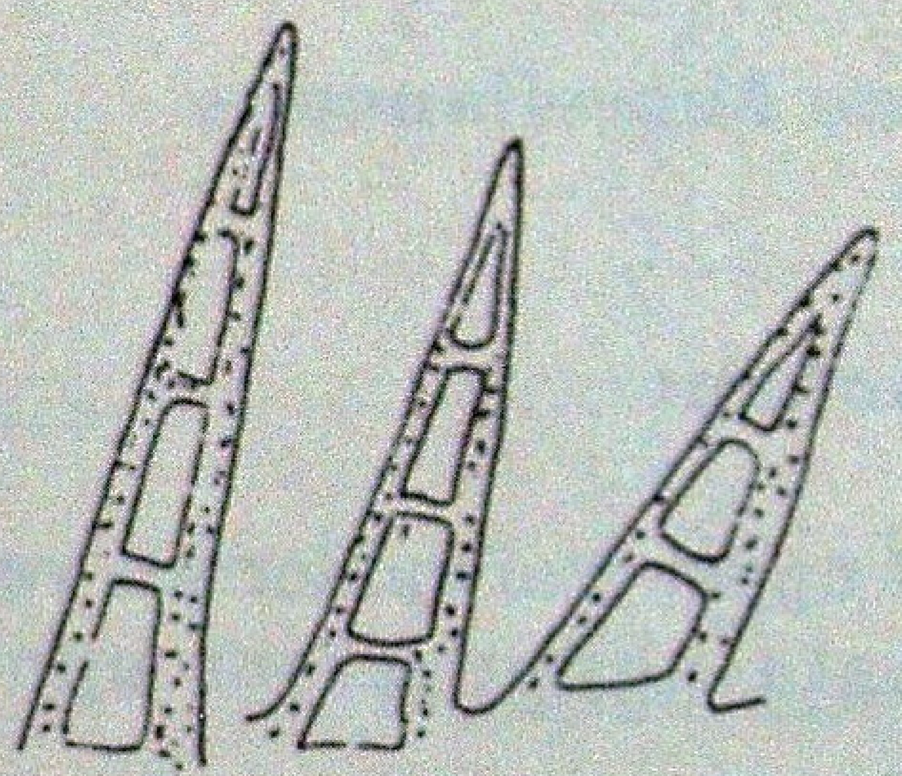
Ageratum conyzoides



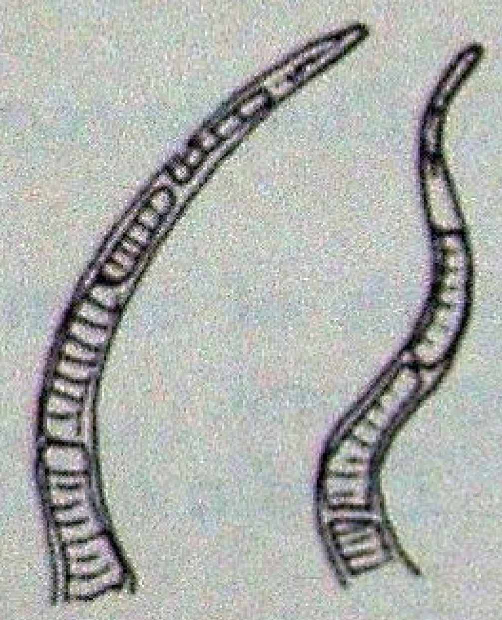
Putranjiva roxburghii



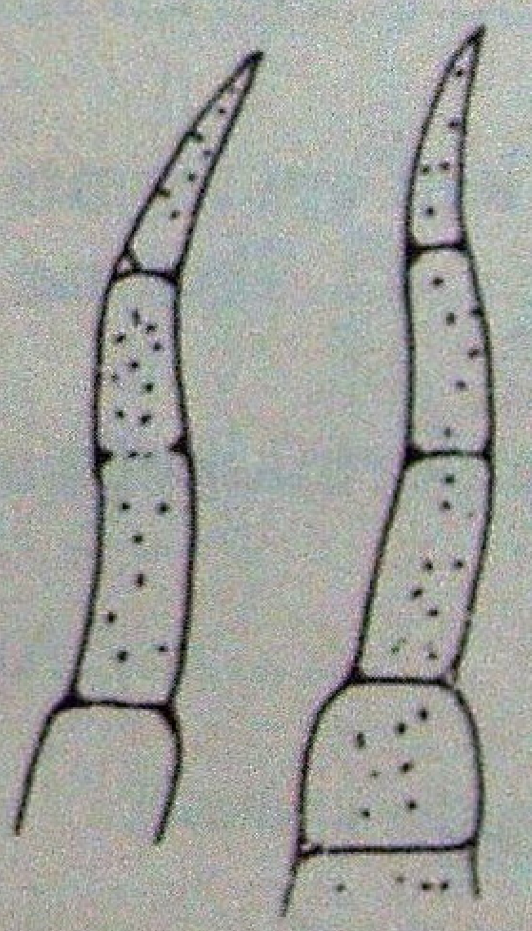
Ichnocarpus sp.



Rungia repens



Bridelia retusa



Adina cordifolia

vascular tissues.

..................*Acacias*

II - **Dimorphic Crystals** :

(a) Large prismatic crystals, occurs in mesophyll cells, cortical cells and pith cells i.e. in the soft-tissues. Distributed randomly. Not associated with vascular tissues.

(b) Crystals in rosettes, positioned and distributed as above.

................*Emblica officinalis*

3. Key based on Miscellaneous Structures

I - *Epidermal features* :

(1) Cell walls of upper leaf epidermis very sinuous, stomata absent from upper epidermis.

............*Diospyros melanoxylon*

(2) Stomata anomocytic.

..............*Rungia repens*

(3) Stomata diacytic, width of stomata including guard cells 28 microns.

..........*Cordia obliqua*

(4) Stomata sunken on amphistomatic leaves.

..........*Aerua tomentosa*

(5) Sinuous cells in leaf epidermis.

............*Tectona grandis*

(6) Long and short epidermal cells arranged in parallel rows.

..............Any grass

II - *Sclereids in leaves*

(1) Sinuous sclereids on either side of veins in the ground parenchyma. They are rod shaped on the vascular tissue of veins.

...........*Desmodium pulchellum.*

(2) Sclereids interspersed with epidermal cells, rectangular, elongated sometimes oval in shape, frequently localised at certain places.

...........*Flemingia chappar*

(3) Sclereids found scattered in the mesophylle mostly oval in shape.

............*Cassia tora*

(4) Sclereids concentrated in large clusters in the parenchyma cells, varied in shape.

...............*Cordia obliqua*

(5) Sclereids, rounded or oval in shape, in small to large clusters or solitary. Located in mesophyll

..............*Zizyphus mauritiana*

4. Key based on Fruit and Seed tissues

(1) Macrosclereids in the seed tissue and fruit epidermis, without crystals inside. Clusters of small rounded stone cells in the seed coat.

............*Millotia auriculata*

(2) Macrosclereids in the fruit tissues, with prismatic crystals inside.

............*Helicteres isora*

(3) Large clusters of angular stone cells in the fruit tissue.

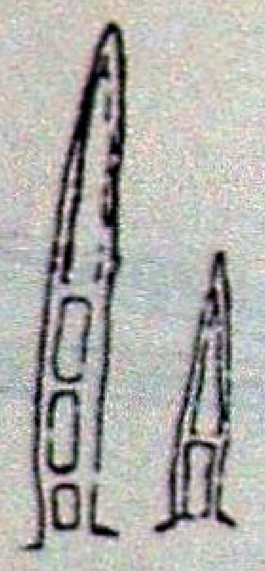
.............*Terminalias*

(4) Sinuons stone cells occurring in groups in fruit wall.

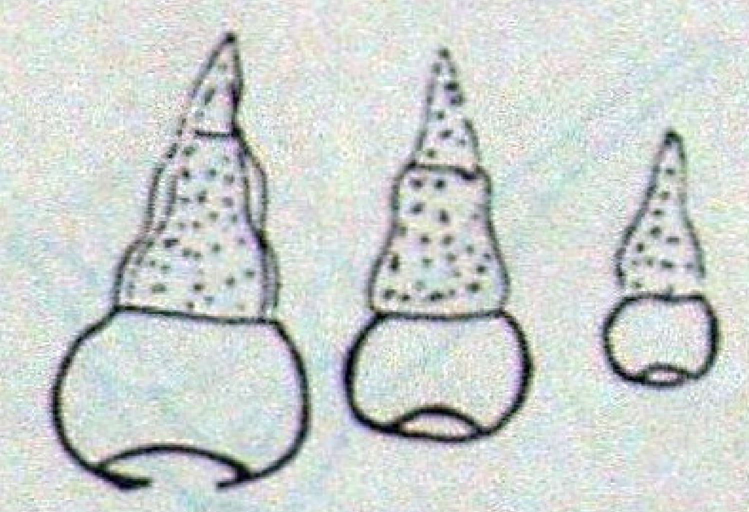
.............*Tectona grandis*

(5) Sligthtly thick walled stone cells with broad lumen and fine pits, length of cells

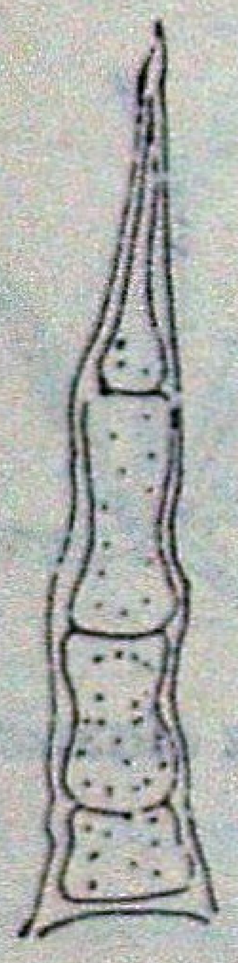
Trichomes of Different Plant Species



Vitex negundo



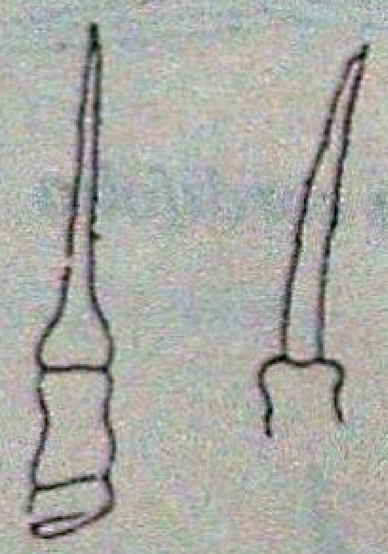
Xanthium strumanium



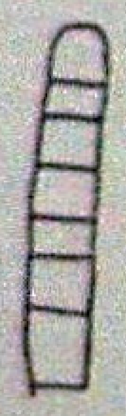
Tridax procumbens

Adhatoda vasica

Euphorbia hurta

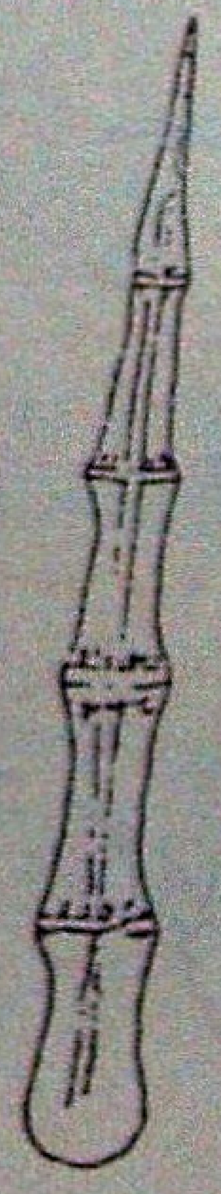


Achyranthus aspera

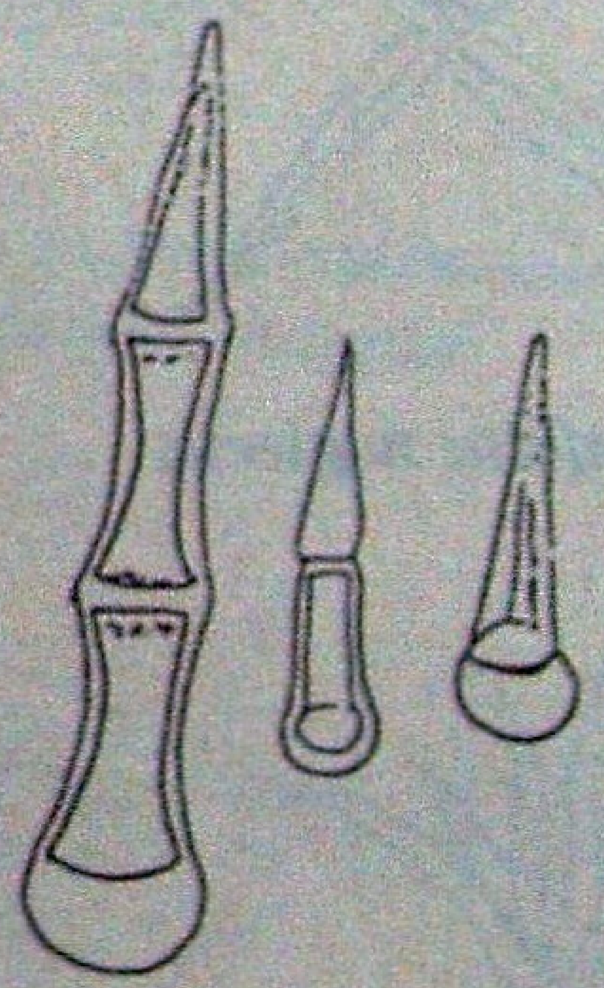


Emblica officinalis

Terminalia bellerica

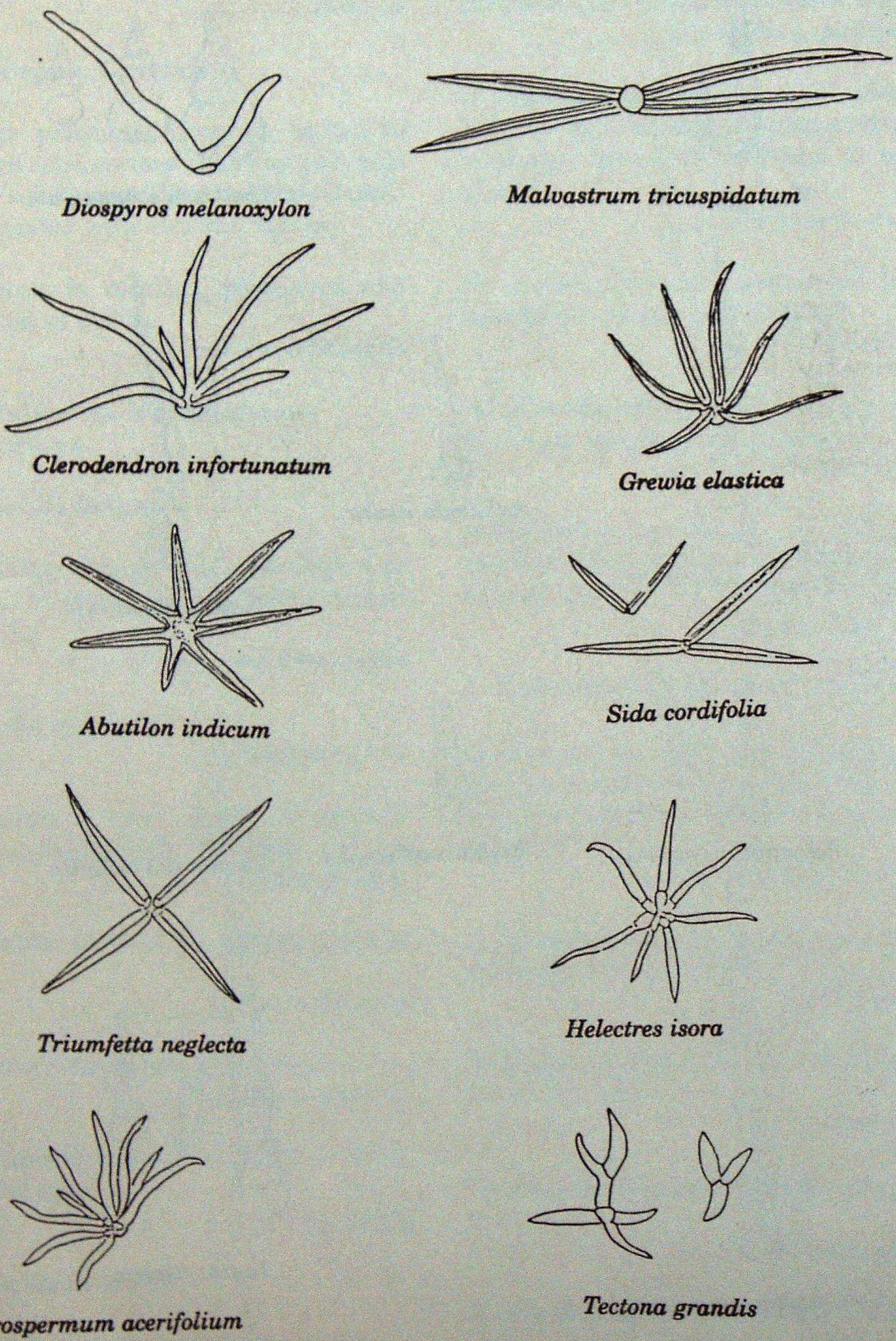


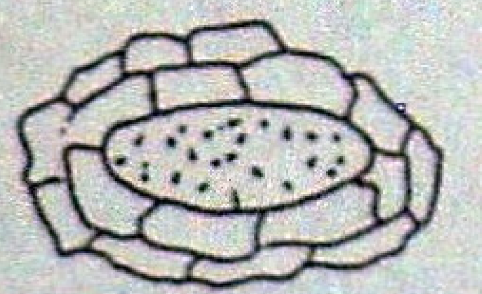
Colebrookia oppositifolia



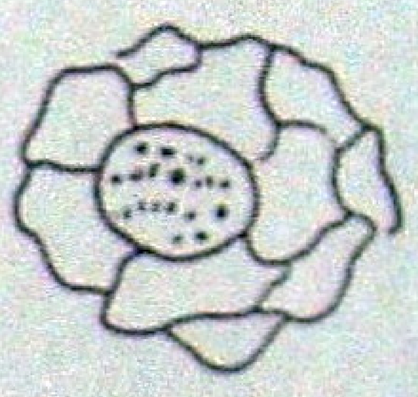
Leucas aspera

Trichomes of Different Plant Species

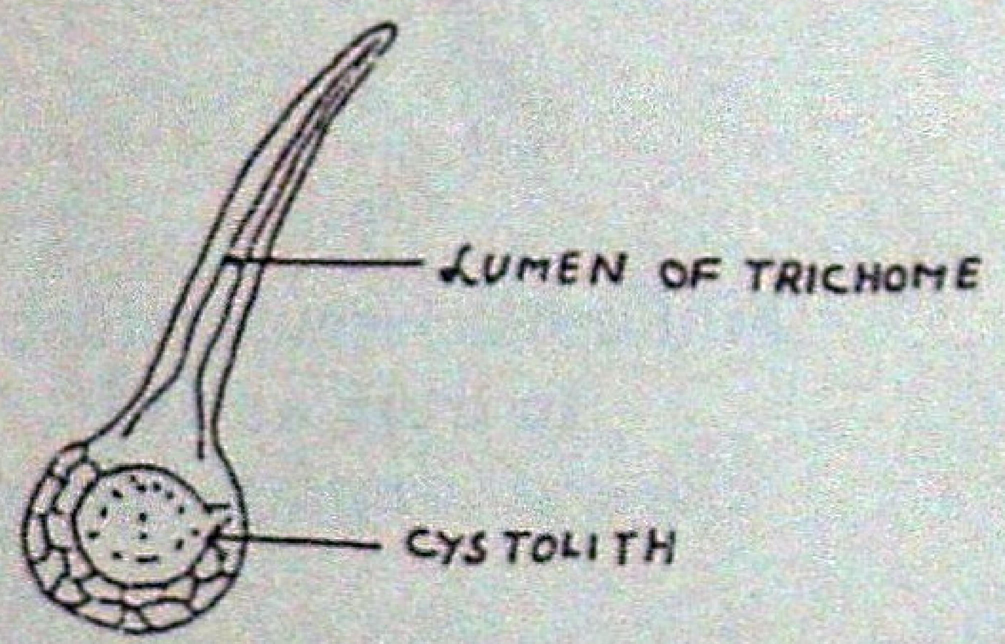




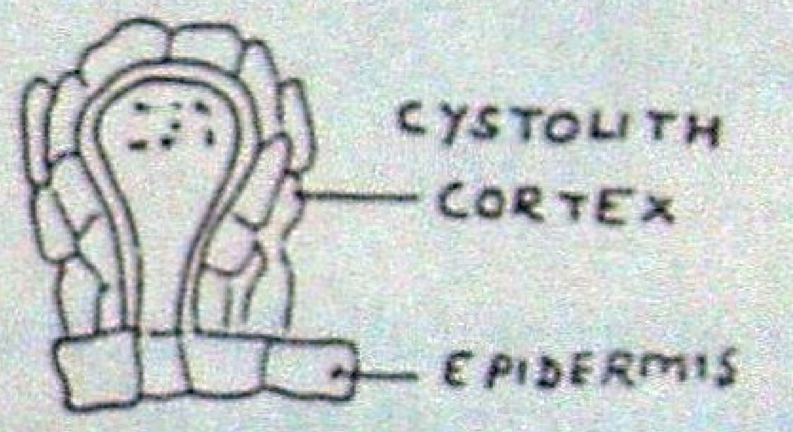
Cystolith of
Adhatoda vasica



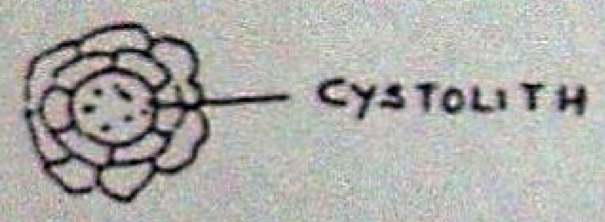
Resin cell of
Woodfordia fruticosa



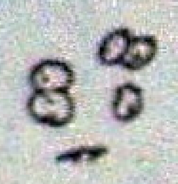
Trichome with a basal cystolith
in *Diospyros melanoxylon*



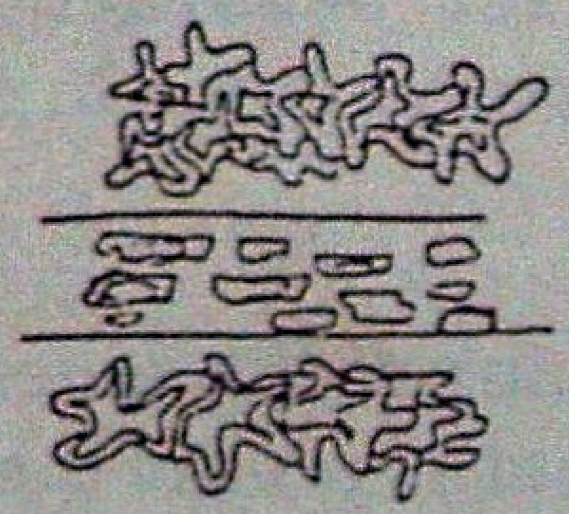
Rungia repens



Tectona grandis

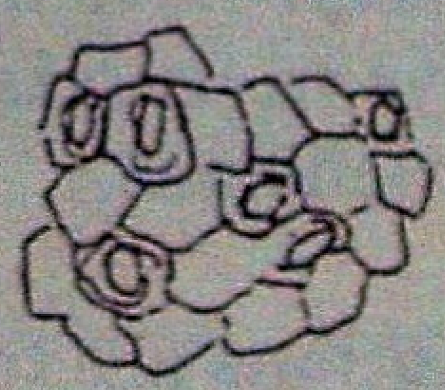


Sclereids in the leaf of
Zizyphus mauritiana

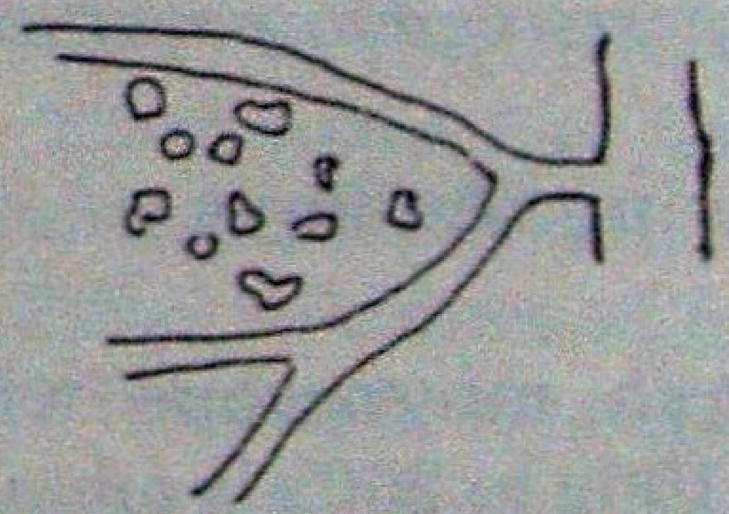


Schlereids in leaf
Desmodium pulchellum

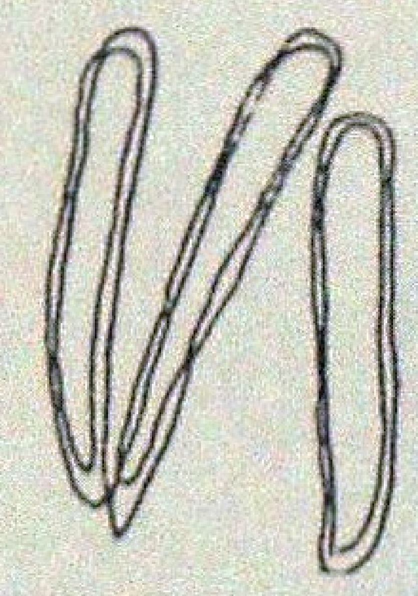
Sclereids in stem spidermis
Flemingia chappar



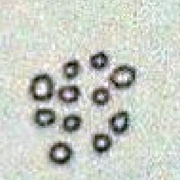
Sclereids in mesophyll tissue
of *Cassia tora*



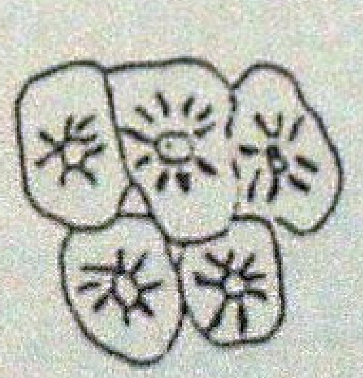
Sclereids in leaf
Cordia obliqua



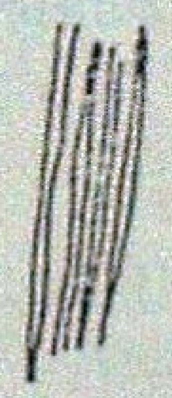
Macrosclereids in fruit epidermis
of *Milletia auriculata*



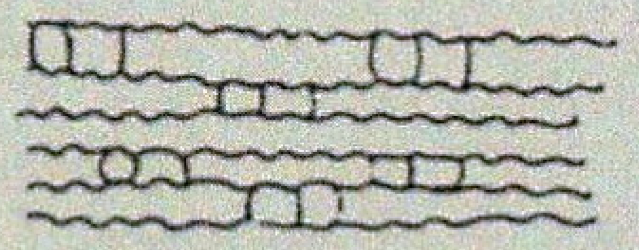
Cluster of stone cells in seed
coat of *Milletia auriculata*



Cluster of stone cells from fruit
pulp and fruit skin of
Zizyphus spp.



Filiform sclereids (clusters)
in fruit wall of
Lagerstroemia parviflora



Structure of epidermal
piece of grass

always over 520 microns. Occur in fruit tussue.

............*Emblica officinalis*

(6) Clusters of irregular, very thick walled and pitted stone cells, 105 microns in length and upto 90 microns in width. Lumen containing dark material. Occur in fruit pulp and fruit skin.

.............*Zizyphus* ssp.

(7) Filiform sclereids occurring in clusters in the fruit wall.

...........*Lagerstroemia parviflora*

Methodology of using the keys

A good research microscope with magnification from 100x to 200x is enough for the study. Use of stage micrometer and ocular micrometer is a must since almost all the characteristics used in the keys have been described by their dimension. Use of camera lucida for drawing and stereomicroscope for separating out dissimilar plant structures found in pellets, is desirable.

Thorough scanning of the slides, field by field, to cover the entire area of the slides under the cover slip covering the debris has to be done.

Supplementary keys have never to be used alone but always in association with main key based on trichomes.

Following precautions are to be taken while using the key.

(i) In their present form the keys should normally be used to identify plant material

in pellets collected in winter season since these have been based on the study of plant material and pellets collected during the winter season. Although, the keys can be used in other seasons also, but minor additions are required to be made, by the study of plant and plant parts and the pellets collected during those seasons, in order to identify whole range of plant remains the faecal pellets. For instances, no trichomes could be traced on the plant parts collected from *Carissa carandas, Bombax ceiba, Syzygium, cumini, Ficus* ssp. *Ougenia oojeinensis, Toona ciliata, Lannea grandis* and *Cassia fistula* during winter season. Because of this limitation, these species could not be included in keys. Other characters which could be solely assigned to these species were also not found. At this juncture, it is difficult to go to the extent of saying that trichomes are absent from these species because possibility of the ephemeral trichomes always exists. In still other but few cases, plants were in leafless condition; in such cases it was very difficult to correlate the leaves collected from forest floor to various plant species excepting a few cases where leaves were quite characteristic for the species and their assignment to the species were no problem. This is another limitation which prevented some species from their inclusion in the keys.

These limitations can be overcome by studying plants and plant parts of the species which have been left out from the keys and their subsequent inclusion in the keys. Once this is done the keys can be satisfactorily applied to all seasons.

(ii) Large number of pellet samples are required to be collected from the field for studying various aspects of food habits. Statistically designed sampling procedures must be followed to collect the representative samples for study.

(iii) Detached crystals are quite helpful in assigning them to plant species to which they belong especially when the morphology and dimensions are studied. But when crystals are found in association with other tissues, it has to be ascertained that they are found in the intact cell i.e. they are really associated with their parent cell and are not loosely associated with the tissues of the plants to which they do not belong. In the latter case erroneous conclusions may be drawn.

(iv) It has to be made very clear that the broken fibres of vascular systems are not confused with broken trichomes. Broken vascular fibres are characterised by the simultaneous presence of greater width, wide lumen irregular blunt tip and slit pits. Plant anatomy specialists are required to be consulted in case of confusion.

(v) A common phenomenon seen in the slides prepared from the pellets is the aggregation of various plant particles belonging to various plant species. In such cases various plant particles should be treated as a separate unit unless there is reason to believe that they belong to the same species, based on the actual tissue connection between the adjacent particles. Sometimes, one more prominent and casily identifiable particle may lie over less prominent ones making the identification of latter even more difficult rather impossible as they are not noticeable. In still other cases the arms of branched trichomes get broken and appear as broken unicellular trichome; although the detailed study of the structure and dimensions will solve the problem but such cases are no less puzzling especially for the beginers in the field.

(vi) The various keys have been based on the comparative studies of slides prepared from plant material with those prepared from faecal pellets. After having compared these the keys have been finally based on the characteristic as they are seen in slides prepared from plant material. While doing so, some of the plants which did not have their particles in the faecal pellets but which were intended to be included in the keys for future reference for studying other pellet samples, have been included in the keys only on the basis of the study of plant material.

Although the same procedure is followed in the preparation of slides from plant material and faecal matter but the same characteric appears to be slightly changed in the latter. In case of trichomes, for example, the cuticle of the trichome may get lost thereby causing a change in the morphorology of the walls. But this changed morphology is not constant, from species to species and from sample to sample. This is precisely the reason that the keys have been based on the basis of characteristics as they are seen in reference slides prepared from pure vegetative powders, and which may serve as standards. Whatever may be the degree of changes referred to above, the detailed study of the plant remains in the pellets including their study under high power of microscope will finally lead to their proper identification.

(vii) The key has been provided with most of the diagrams especially with regard to the main key. There should be no problem for using the key without studying the reference slides by making us of various morphological characters and dimensions described in the key.

(viii) In the field one of the important precaution to be taken in that the pellet samples collected must be relatively fresh i.e. they have to be collected before their disintegration starts.

Discussion

The study of food habits of various wild animals is of paramount importance in wild life management practices. Such studies are also helpful in law enforcement. There are three methods which are in use for studying food habits. First method consists in the direct observation of the animals while they are actually feeding on the plants in wild. This method requires that animals should be followed closely, if less conspicuous kinds of food are also required to be disclosed. Field observations often furnish considerable information concerning the kinds of food consumed but following animals closely over a large period of time is the main practical difficulty with this method. It is because of this difficulty that sometimes misleading results may be obtained with direct observation method. In the second method contents of digestive tract of killed or freshly dead animals are identified. This procedure has the advantage of showing more accurately what an animal has actually ingested; but has the disadvantage that the animal must usually be killed or a freshly dead animal has to be searched. The information obtained from this method is of one meal only or a portion of meal. It also gives no information on where the food was obtained. The third method consists in analysing animal faecal matter to identify indigestible or undigested parts which are present in practically all kinds of food, and eliminated out from the animal body along with the faecal matter.

The identification of indigestible or undigested food parts becomes easy if a key exists for identification of such parts as to their origin. With this idea in the present

work, keys for the identification of various plant parts in the faecal droppings of ungulate species feeding upon various plant parts having different origin, have been prepared, Such keys have to be different for different areas since the vegetational composition differs from area to area. The keys prepared for one area, if used for another area may lead to erroneous conclusions as this area will have different elements in the vegetational complex. In the present work the keys prepared for study area have been tested for their validity. The criteria used are the same as the ones used by Satakopan (1972). One wonderful criteria has been provided for the purpose by various characteristics of trichomes on which main key has been based. A closer appraisal of the key based on trichomes shows that there is sometimes considerable uniformity in trichomes within a plant group. On the other hand, the fact that trichomes may show variations within families and the smaller plant groups, and even in the same plant species is also indicated in the key. Plant hair types have been successfully used in the classification of genera and even of species in certain families and in recognition of inter specific hybrids (Cowan, 1950; Heintzelmann and Howard, 1948; Metcalfe and Chalk, 1950; Rollins, 1944). The present studies have also confirmed the constant and specific nature of the trichomes as the findings in the present work with regard to trichomes of *Acacia* ssp., *Anogeissus latifolia, Emblica officinalis, Terminalia bellerica, Diospyros melanoxylon, Helicteres isora* and *Zizyphus mauritiana* are similar to those in the work of Satakopan which also included these species. Almost similar conclusions can be drawn regarding the criteria used in preparing supplementary keys.

Key for the identification of grass species has not been attempted because identical characteristics of trichomes in all grass species do not permit their use for the preparation of such a key.

A key for the identification of grass spp. could have been prepared on the basis of epidermal cell characters as they are seen in pure grass material put such an attempt would have been futile as minute epidermal pieces that are seen in the pellets do not reveal cell characteristics. Satakopan (1972) has also found the same difficulties in the preparation of a workable key for identification of grasses upto the level of species. Probably sophisticated biochemical analysis will solve the problem which still remains.

Such keys as have been presented in this work will help in the study of various aspects of food habits including the establishment of palatability gradient of wild animals. For instance,if 100 pellet samples of a particular ungulate species have been collected following a statistically designed sampling procedure; and five slides have been prepared from each sample. Then if a plant species occurs in 490 slides out of 500, where as other plant species B occurs in 450 slides and still other species C occurs in 400 slides; than the species A will occupy the highest position in the palatability gradient. The species B and C will follow. thus the palatability gradient for that particular ungulate species can be written as A, B, C. In this method, the number of cases (slides) of the occurrences of a plant species have been correlated with the preference with which that plant species is eaten by the ungulate species. In the opinion of the author such a correlation should work.

But the palatability for a plant species will depend on the availability of various species as food in the area occupied by the

ungulate species, which goes on changing with season. Also, the availability of the annual plants entering into the composition of ground flora from year to year depends, amongst other factors, on the level of moisture in the soil which affects their emergence (Sharma, 1975). Therefore along with the studies on seasonal changes in the vegetation resulting from the various qualifiers in the area, the ecological studies of the ground flora, which will indicate the extent of availability of different species as food in the ground flora, should be made. Such studies should include the determination of relative frequency, relative density, relative cover for calculating importance value indices of various species. Determination of biomass should also be included in these ecological studies. Ecological monitoring can be done with the help of properly laid out samples based on conventional ecological methods. In the opinion of author such ecological monitoring should go hand in hand with the food habit study, if the latter is really intended to draw meaningful conclusions.

SUMMARY

This paper presents keys for identification of plant remains in faecal matter of ungulates. These Keys are useful in identification of indigestible or undigested food parts which are eliminated out from the animal body along with faecal matter. Main Key is based on trichomes and for cross checking the main key, supplementary keys have been based on features like crystals, epidermal cell characteristics, stomatal characteristics, sclerides, structural pecularities in fruit and seed tissues that are present in faecal matter of ungulates.

हिरणों के मेंगनी में पादप अवशेष पहचानने की कुंजियाँ

आर०डी० शर्मा

सारांश

इस अभिपत्र में हिरणों की मेंगनी में मिलने वाले पादप अवशेष पहचानने की कुंजी प्रस्तुत की गई है । यह कुँजी उन अपचनीय अथवा अनपचे भोजन अंशों को पहचानने में उपयोगी है जो पशुओं के शरीर से उनकी विष्ठा के साथ बाहर निकल आते हैं । प्रधान कुंजी ट्राइकोमों पर आधारित है तथा तिर्यक जाँच के लिए संपूरक कुंजियों स्फटिकों, उत्स्तर कोशा विशेषताओं, मुखीय विशेषताओं, स्कलेराइड, फल और बीज ऊतियों की संरचनात्मक विभिन्नताओं पर आधारित की गई है जो हिरणों की विष्ठा में पाई जाती है ।

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SUCCESSFUL CAPTIVE BREEDING OF STUMPTAILED MACAQUE IN SRI VENKATESWARA ZOOLOGICAL PARK, TIRUPATI (ANDHRA PRADESH)

S.V. KUMAR* AND P.S. RAGHAVAIAH**

Introduction

The Stumptailed Macaque (*Macaca speciosa*) is restricted to Assam hill forests only in India. It is a Schedule-II animal. The tail of Stumptailed Macaque is scarcely 2.5 cm long. The animal is thick set in build, with long and abundant hair and hair is slightly parted in the middle. Shoulder is wavy and middle of the back is parted. Large area of the seat is bare, brilliant red or purple patches are seen on the face, on the genital region and in posterior region. Head and body is dark brown, young individuals are paler in colour.

Habits

The Stumptailed Macaque is more at home on the ground than upon the trees contrary to the other Macaques which are more arboreal in nature. They eat chiefly young leaves, fruits, buds and occasionally small prey. Where opportunity offers, they can leave the forest to raid fields and gardens for maize, sugarcane, rice papayas and mangoes.

Breeding Activities

The sex life of the Stumptailed Macaque seems to have a special social significance, because mating is less restricted to the period of female fertility than in other primates. Mating takes place throughout the year giving a gap of 2 months after delivery and participate even after its conception. After ejaculation, the male is unable to detach himself from the female immediately, much as in canines. This is due to a swelling at the entrance to the vagina. The female will sit "tight" on the male's lap, the male will hold the female for sometime. Both mother and father show affection to the baby, but father does not share his food with baby. But the mother takes much care of the young ones. When it gives a call, the male also will come to rescue the baby. There is a case when the mother didn't leave the dead body of her baby even 5 days after death.

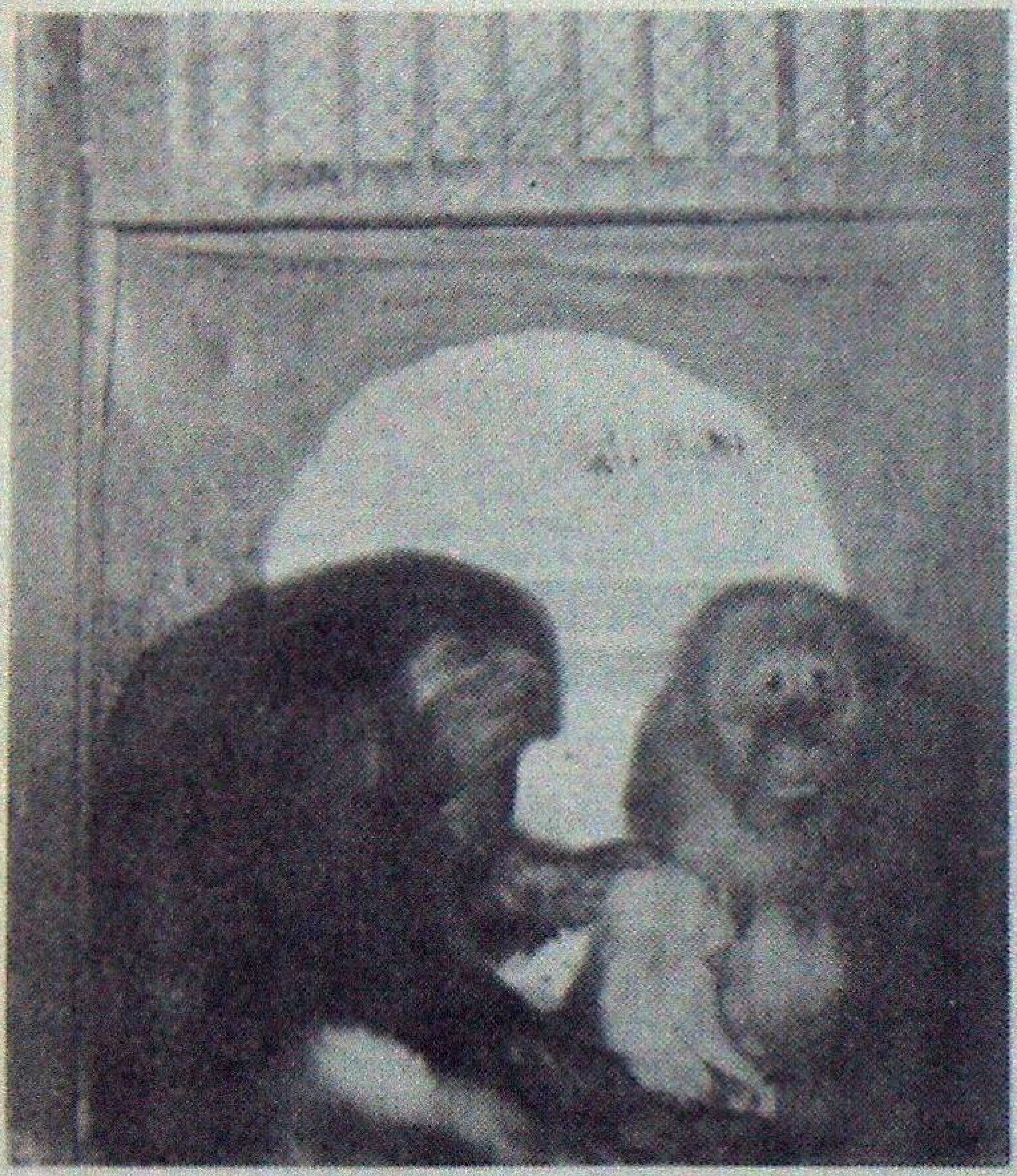
Enclosure for Stumptailed Macaque

The enclosure for Stumptailed Macaque is constructed with an island area of about 275 m^2. This has a top width of 5 m. and a depth of 2.3 m and designed as a wet moat. About 60 cm water level has to be maintained. 60 cm high Parapet wall is constructed above ground. Hedge plants are raised in between the railing and moat wall.

Night house is provided with four cages of 1.2 m x 1.65 m x 1.50 m size each. Night house is camouflaged with rockery. Drainage channel is provided for easy draining of daily cleaning water.

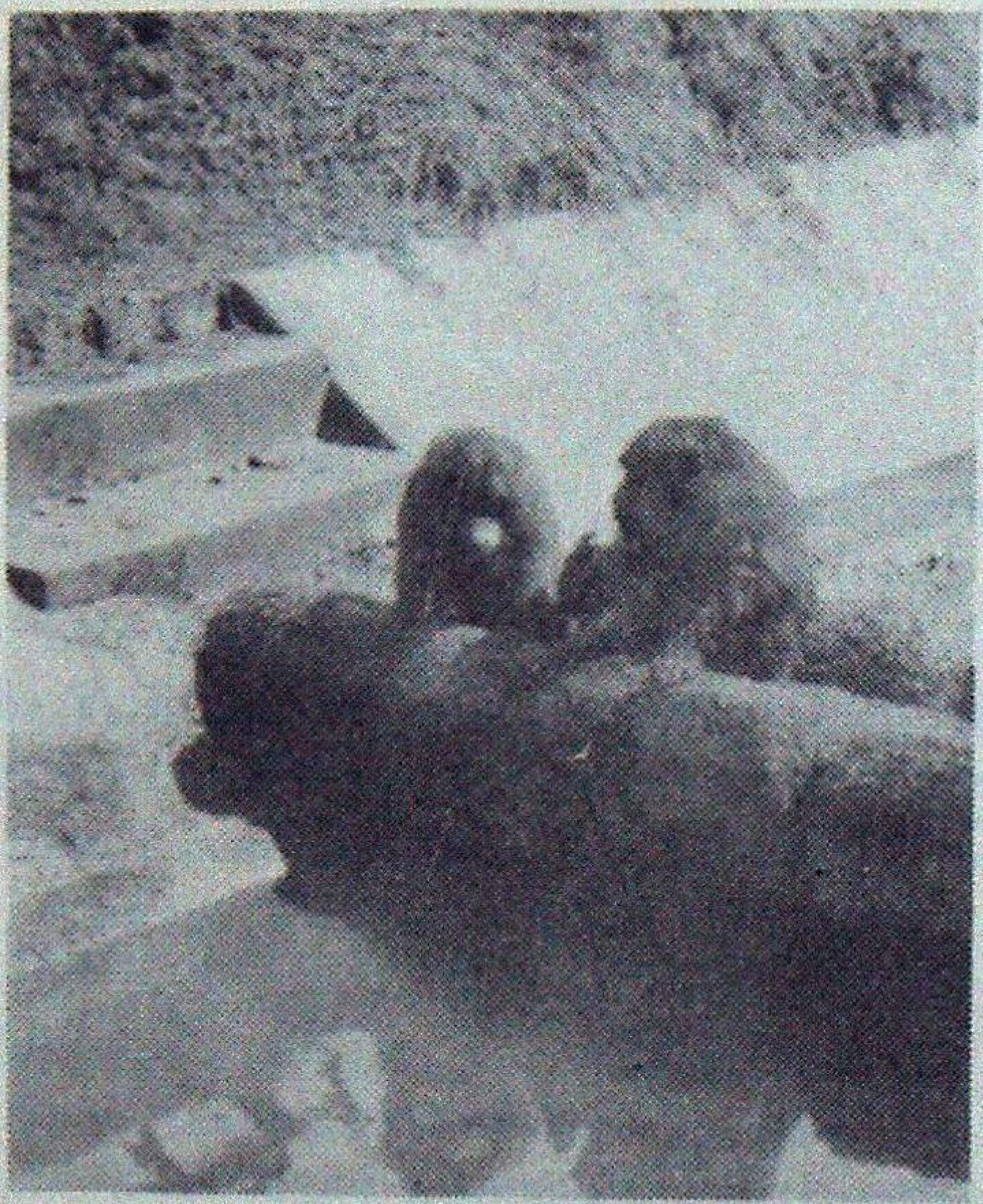
* Conservator of Forests, Wildlife Management Circle, Tirupati (Andhra Pradesh)
** Curator, Sri Venkateswara Zoological Park, Tirupati (Andhra Pradesh)

Fig. 1



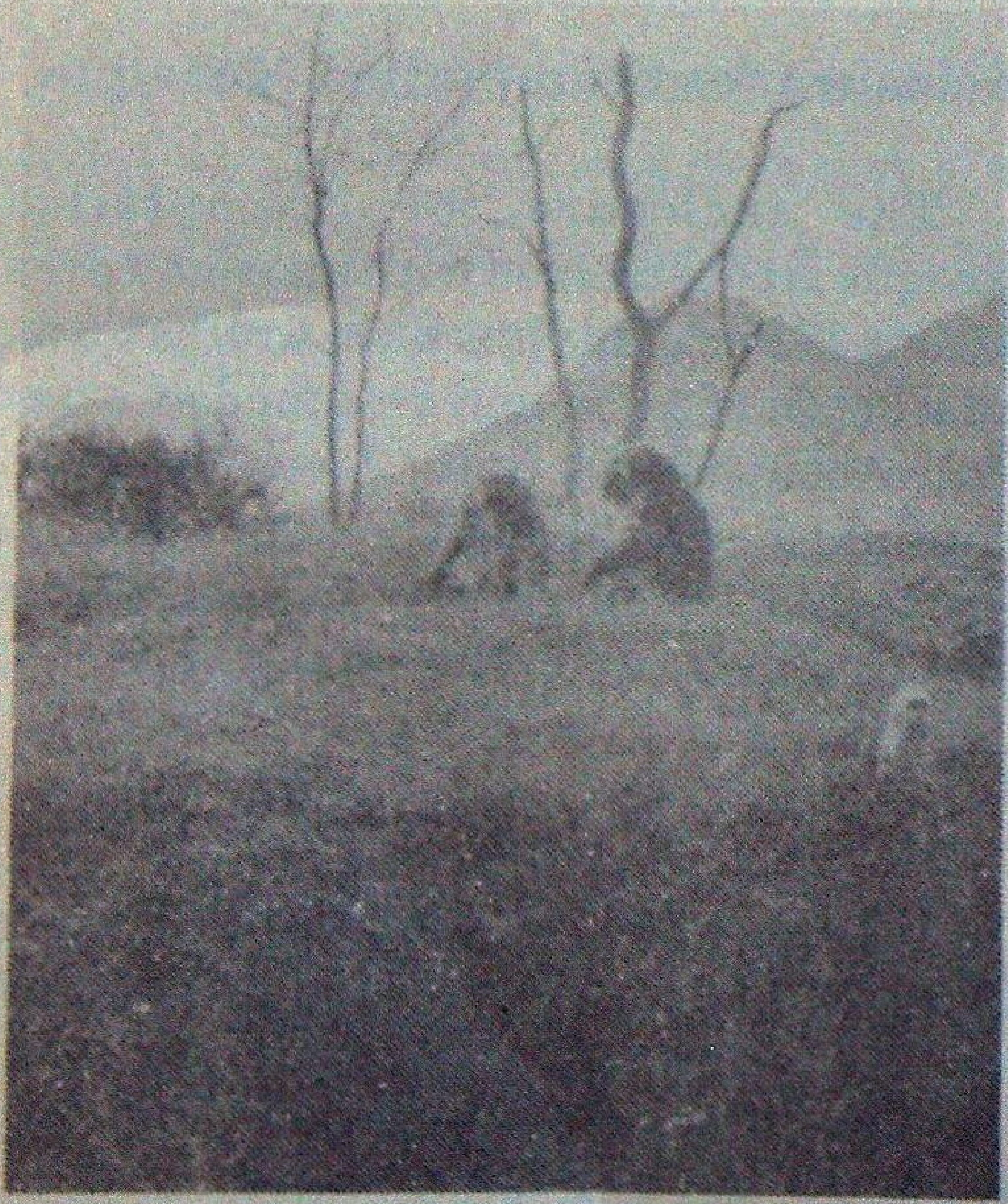
One-day old baby Stumptailed Macaque with its mother and father

Fig. 2



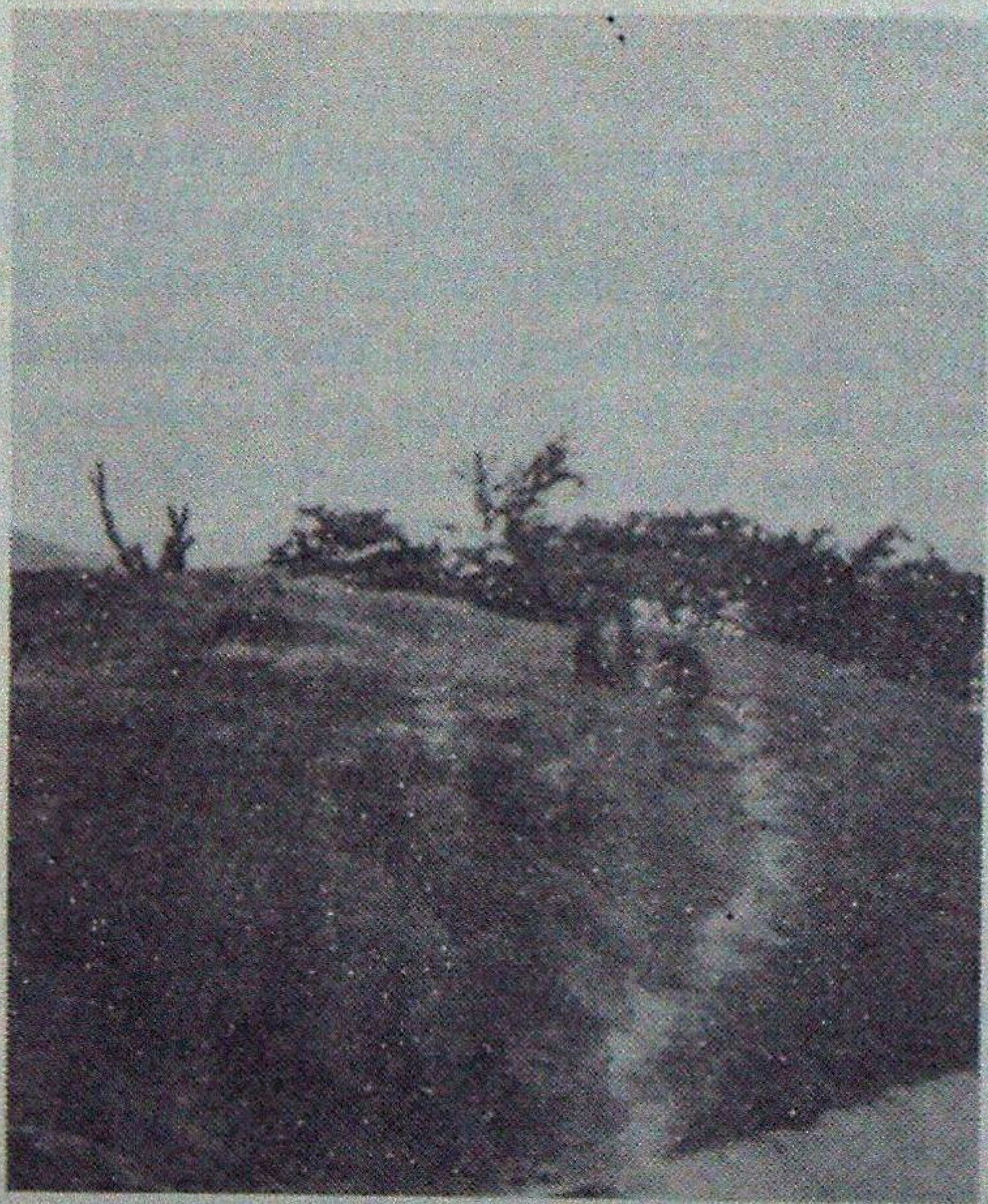
Baby Stumptailed Macaque feeling security with its mother and father

Fig. 3



Mischievous baby Stumptailed Macaque playing in the enclosure leaving parents.

Fig. 4



Mother grooming the baby Stumptailed Macaque

Prophylactic Measures

Each animal is provided with bread - 100 g, Vegitables - 75 g, Bananas - 250 g, Vegitable leaf - 50 g, Bengalgram - 100 g and fruits - 210 g in a day. The night house is cleaned daily with Steridor or Aciphor liquid. The moat is disinfected monthly in all the months except twice in a month in rainy season with bleaching powder. Butox is sprayed monthly around the night house and around the moat for pest control. Faecal samples are examined monthly for detection of parasites. Deworming is done once in three months.

Successful Breeding

One male and one female were brought from the Nehru Zoological Park, Hyderabad in the year 1993. They have given birth to a baby on 26.8.93. After nearly one year the baby died under the releasing gate. On 4.8.94 the male macaque lifted the gate and it was holding the gate. At that time the baby was playing near the gate. When the baby was below the gate the male macaque suddenly left the gate. The baby was crushed under the gate.

Second time one more baby was born in 1994. When the baby was one week old, it has tried to cross the cage bars to enter into another cage but only its head has gone to the other side and its boby could not pass through the bars as the gap between the bars is less. The mother pulled the baby from the other side of the cage holding its head instead of pulling back the baby. As a result of this, the baby was squeezed in between the bars and died.

With the experience of these incidents, the following steps were taken to avoid further deaths :

1. Gap between releasing gate and wall above the gate was reduced.

2. Opening of the releasing gate throughout, till the baby crosses juvenile stage.

3. Knitting of chain link mesh to the sides of central cage to prevent the baby crossing the cage bars.

4. Observing the baby and the gate position daily by the Animal Keeper, Animal Watchman and Zoo Sargeant.

Again one baby was born on 20.6.1995. By taking the above steps the baby is growing well and it is in good health. The baby is now becoming dark in colour. The baby has successfully competed one year now in the Sri Venkateswara Zoological Park, Tirupati.

Conclusion

Close supervision of the baby, narrowing the gap between gates and walls, opening of the releasing gate all the time and restricting the movement of the baby through the bars of the night cage made the Stumptailed Macaque baby survive. With these precautions and careful observations, the female Stumptailed Macaque which is pregnant now may deliver another baby Stumptailed Macaque which may successfully grow into an adult taking their family size to 4 from the present family size of 3. The Sri Venkateswara Zoological Park, Tirupati is not enforcing family planning for its animal, the family size of these Stumptailed Macaques may grow into a viable population from the parent stock of one male and one female.

SUMMARY

Breeding activities of Stumptailed Macaque are discussed. The reasons for their mortality and remedial measures and steps taken for their successful captive breeding are also discussed.

श्री वेंकेटेश्वर प्राणि उद्यान में ठूंठ पुच्छ कपियों के सफल बन्दी प्रजनन

एस०वी० कुमार व पी०एस० राधवय्या

सारांश

ठूंठ पुच्छ कपियों के प्रजनन गतिविधियों का विवेचन किया गया है । मृत्यु दर कारण तथा प्रतिविधि परिणाम व उनके बन्दी अवस्था में किये गये सफल प्रजनन पदक्षेप का भी विवेचन किया गया है ।

STATUS OF THE ELEPHANTS IN KULDIHA SANCTUARY, ORISSA

D. SWAIN*

Introduction

The Kuldiha Sanctuary is located between 21°20' and 21°30' North latitude and 86°30' and 86°45' East longitude (Fig. 1). In area it covers 272.75 km², in the Nilagiri Range of Balasore District. It was declared a sanctuary by the Government of Orissa in 1984. Kuldiha formed part of the former Nilgiri Feudatory State and has enjoyed the status of a reserved forest since 1900 when the then ruler Raja Shyama Chandra Madharaj Harichandan framed rules for the protection and management of the forests in his State. The Sanctuary is rich in Sal trees (*Shorea robusta*) Forming about 60% of the trees of the 'Coastal Sal Forest'. The principal wild mammals inhabiting the areas are the Elephant (*Elephas maximus*), Bison (*Bos gaurus*), Spotted Deer (*Axis axis*), Barking Deer (*Muntiacus muntjak*), Sambar (*Cervus unicolor*), Sloth Bear (*Metursus urcinus*), Wild Boar (*Sus scrofa*), Leopard (*Panthera pardus*) and Jungle Cat (*Felis chaus*).

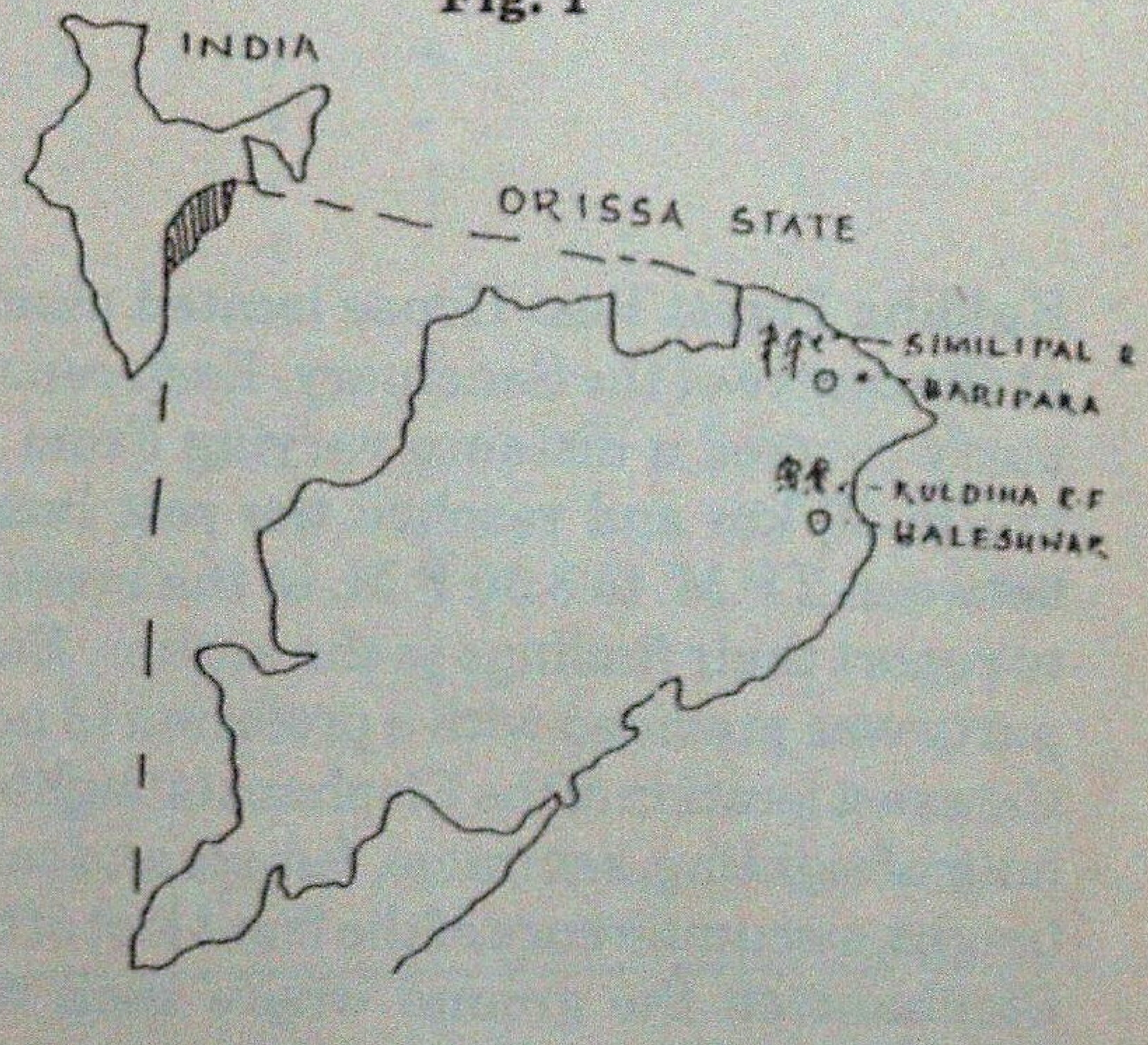
Except for passing reference about the Sanctuary very little is known about the wildlife of the area. In the official records, the Field Director, Similipal Tiger Reserve, Baripada, reports the occurrence of 22 elephants comprising 4 tuskers, 13 females and 5 calves in the Sanctuary based on an Elephant census conducted in May, 1979.

The author, in order to gain first hand information about the status of Elephant in the Sanctuary, conducted two censuses, one in June and the other in December, 1992, the results of which are given below.

Materials and Methods

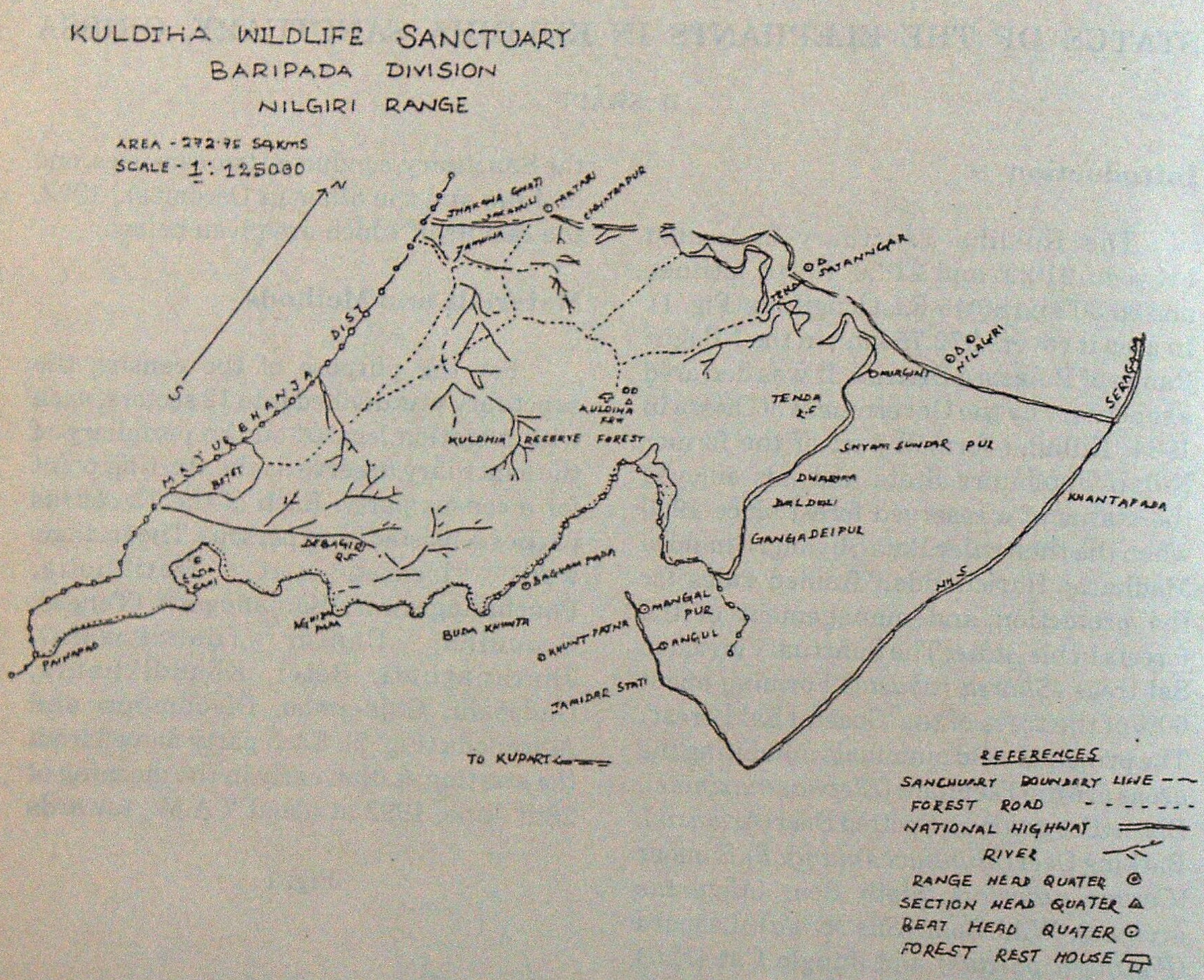
For the purpose of the census, the sanctuary was divided into 12 sectors, each with a station located on the periphery of the sanctuary to serve as the starting point for a census party. Each of the 12 census parties consisted of six persons. The stations were located at Hatikholia, Panchalingeswar, Sanjanagarh (Tenda), Garadiha, Dantur (Bandhasahi), Jharanaghati, Betei, Khaddikhania, Gadasahi, Gaja-ambo, Digbhaunra and Agirapada (Fig. 2). Each party moved from the starting station early in the morning of 28th June, 1992 at about 7 A.M., towards

Fig. 1



* Silviculturist, Orissa, Ghatikia, Bhubaneswar.

Fig. 2



Kuldiha Forest Rest House located almost at the centre of the Sanctuary. Each census party covered a distance varying From 11 km to 30 km and reached the rest house between 2 P.M. to 8.30 P.M. in the evening to report their findings to the author. Each party was provided with a proforma to note the exact location of the Elephant (s) sighted, hour of sighting, sex (male, female and calf), height, circumference of the front foot of the Elephant on the ground where such was available, sighting of Elephant dung, activity of the Elephant (e.g., grazing, standing, swinging the proboscis etc.) and any other information considered to be relevant. A similar census was conducted again on 11 December, 1992. The results are set in Table 1 and 2.

Results

The census of June, 1992 showed the Elephant population in the sanctuary to be 24 divided into 7 groups while in December, 1992 the population figure was 36 divided into 11 groups. The variation of number in the two censuses within a period of six months is explained by the fact that the

Table 1

Elephant census in Kuldiha Sanctuary: Balasore : Orissa : India on 28.06.1992

Starting point of the census group	Elephant group	No. of Elephants in the group	Approximate Elephant height: Young Less than 4'			Sub-adult 4' to 7'			Adult above 7'		
			M	F	UN	M	F	UN	M	F	UN
Panchalingeswar	A	7	-	-	1	1	5	-	-	-	-
Dantur	-	-	-	-	-	-	-	-	-	-	-
Sajanagarh	B	2	-	-	1	-	1	-	-	-	-
	C	2	-	-	-	1	1	-	-	-	-
Gajamba	D	4	-	-	1	1	2	-	-	-	-
Betei	-	-	-	-	-	-	-	-	-	-	-
Garasahi.	-	-	-	-	-	-	-	-	-	-	-
Gadadihi	-	-	-	-	-	-	-	-	-	-	-
Agarapada				Not concluded							
Hatikholia	E	5	-	-	1	1	3	-	-	-	-
	F	1	-	-	-	1	-	-	-	-	-
Digbhanura	-	-	-	-	-	-	-	-	-	-	-
Jharanaghati	G	3	-	-	-		3	-	-	-	-
Khedikhania	-	-	-	-	-	-	-	-	-	-	-
	7	24	-	-	4	5	15	-	-	-	-

UN- Sex not known, F - Female, M - Male.

Table 2

Elephant census in Kuldiha Sanctuary : Balasore : Orissa : India on 11.22.1992

Starting point of the census group	Elephant group	No. of Elephants in the group	Approximate Elephant height: Young Less than 4'			Sub-adult 4' to 7'			Adult above 7'		
			M	F	UN	M	F	UN	M	F	UN
Panchalingeswar	A	9	-	-	2	1	6	-	-	-	-
	B	1	-	-	-	1	-	-	-	-	-
Dantur	C	3	-	-	1	-	1	-	1	-	-
Sajanagarh	D	1	-	-	-	1	-	-	-	-	-
	E	2	-	-	1	-	1	-	-	-	-
Gajamba	F	2	-	-	1	-	1	-	-	-	-
Betei	G	4	-	-	-	-	-	-	-	4	-
Garasahi.	-	-	-	-	-	-	-	-	-	-	-
Gadadihi	H	6	-	-	1	-	5	-	-	-	-
Agarapada	-	-	-	-	-	-	-	-	-	-	-
Hatikholia	I	2	-	-	1	-	1	-	-	-	-
Digbhanura	-	-	-	-	-	-	-	-	-	-	-
Jharanaghati	J	3	-	-	1	-	-	-	1	1	-
	K	3	-	-	-	-	-	-	1	2	-
Khedikhania	-	-	-	-	-	-	-	-	-	-	-
	11	36	-	-	8	3	15	-	3	7	-

UN- Sex not known, F - Female, M - Male.

Kuldiha Sanctuary is connected with the Similipal National Park in the Mayurbhanj District through Sukhuapata and North hill ranges forming part of the Eastern Ghats mountain ranges, which serve as the corridor of migration of Elephants of Similipal hill forests to Kuldiha forests covering a distance of about 20 km.

It appears from the two censuses that the Elephants of the Kuldiha Sanctuary live in highly fragmented groups varying from 2 to 9. Prater (1965) records that Elephants live in herds of five to sixty or more and that herds are believed to be composed of single families which break up into small groups when there is scarcity of food.

Tiwari (1990) reports that in the Periyar Tiger Reserve, Kerala, the herd size depended on the season and availability of fodder. It was minimum in January and February and maximum in April to June when the grass was fresh and green due to pre-monsoon showers. Basavaraju (1990) states that in the Mudumalai Wildlife Sanctuary, Kerala, the Elephant group sizes are 3, 6, 7, 11 and 13. Often younger males (10-15 years) are observed leading solitary life.

In Elephants, females and males are sexually mature when about 15 years old (Basavaraju, 1990). It is presumed that a 15 year old adult Elephant attains a height of 2.1 metres and above. Whereas, no adult was encountered in the Kuldiha Sanctuary during the census conducted in June, 1992. Only 3 males and 7 females were spotted in December, 1992 census. The break-up of the later census indicates that out of a total number of 36 Elephants, 3 are adult males, 7 adult females, 15 sub-adult females, 3 sub-adult males and 8 young. This indicates very low effective population size with very low breeding potential. Unless effective corridor to the Similipal hills is maintained the Elephants of this sanctuary is destined to get wiped out in the human Elephant conflict. Practically nothing is known about the minimum viable population size in the Asiatic Elephant (Anon., 1990).

The period of gestation in the Asiatic Elephant in Kerala is 22±1 months. The young is dropped in all months of the year, the maximum occurring in February, April, May and January (Nair, 1990). Sighting of 4 adult females, and 9 sub-adult juneniles

Table 3

Human interference in the Kuldiha Sanctuary, District Balasore, Orissa.

1. Number of villages within one km radius of Kuldiha Sanctuary. 19
2. Total population within one km radius of Kuldiha Sanctuary. 14,020
3. Regular head loaders entering the forest. 7,507
4. Cattle population depending on the forest (regular grazing). 37,297
5. (a) Head loader density 27.5 km^2
   (b) Cattle population density. 136.7 km^2
6. Yearwise Elephants killed/died and reason are given below :

Year	Killed/Died	
1981	1	(Natural)
1982	2	(Poaching)
1984	2	(Unknown)
1987	1	(Unknown)
1989	1	(Poaching)
1990	1	Unknown)
1991	1	Natural
1992	1	Poaching
1993	1	Poaching
	1	Natural
	1	Poaching
Total	13	

and young without the attendance of an adult/old leader female in the December census and similar sightings of sub-adult and young without an adult female in small groups of 7, 5, 4, 3 and 2 is intriguing.

Although Kuldiha is a Sanctuary and protected by Wildlife (Protection) Act, 1974, the denizens of this forest are subjected to much competition for food with domestic cattle and human interference. Within a radius of one kilometer of the sanctuary there are 19 villages with a total human population of 14,020 (Census, 1991) and cattle population of 37,297 for which the sanctuary serves as the grazing grounds. As surveyed by the author as many as 7,507 people visit the sanctuary daily to collect a head load of firewood to eke out a living by selling in the village fare or market (Table 3).

The Future

As would appear from the foregoing, the Kuldiha Sanctuary is subjected to tremendous human interference in addition to poaching as evidenced by the fact that during the period 1981-1993, death of 13 Elephants were reported, of which 3 deaths are believed to be natural, 6 were killed by poachers and the death of 4 remains uncertain (Table 3).

Due to human population growth interference with the freedom of wildlife of the area is increasing in the form of encroachment, deforestation, livestock grazing, sustained yield forestry, poaching, fire hazards, and various developmental activities. In addition, due to the above reasons the corridor facilitating free movement of Elephants from the Similipal forests to Kuldiha and vice-versa is likely to be cut off due to deforestation and human settlement leaving the Elephants of Kuldiha isolated.

In order to maintain the Elephant population of the Kuldiha Sanctuary, careful land-use planning is necessary to ensure the following :

1. The forest corridor connecting Similipal with Kuldiha should be maintained.

2. Efforts should be made so that the Elephant population increases atleast to 50 in order to counter in-breeding depression.

3. Cattle grazing and collection of firewood are to be severely restricted.

Acknowledgements

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SUMMARY

Elephant census was carried out by the author twice in the Kuldiha Sanctuary of Orissa, one in June and the other in December, 1992. The result of such census has been discussed in this paper. The Elephants in this sanctuary live in highly fragmented groups due to scarcity of food and biotic interference. Suggestions have been made to save this fragmented population from annihilation.

उड़ीसा के कुल्डिया अभिरण्य में हाथियों की परिस्थिति

डी० स्वेन

सारांश

हाथियों की जनगणना, एक जून तथा दूसरी दिसम्बर 1992 में उड़ीसा के कुल्ड़िया अभिरण्य में, जिसके परिणाम इस अभिपत्र में वर्णित है । चारे की कमी तथा जैव अवरोध के कारण हाथी इस अभिरण्य में कई समूह व खण्डों में रहते हैं । इस खण्डीय जनसंख्या को लोप होने से बचाने के लिए सुझाव दिए गए हैं ।

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MICRO-HISTOLOGICAL STUDIES ON THE FOOD HABITS OF SAMBAR, GAUR AND CATTLE IN PERIYAR TIGER RESERVE IN WINTER

K.K. SRIVASTAVA[1], A.K. BHARDWAJ[2], SONY GEORGE[3] AND V.J. ZACHARIAS[4]

Periyar Tiger Reserve, Thekkady (Kerala)

Introduction

Very little studies have been done on the food habits of sympatric ungulates in India. Some preliminary studies were done by Shcaller (1967) on the food plant of wild ungulates in Kanha, Berwic (1976) in Gir and Johnsingh and Sankar (1991) in Mundanthurai. Green (1985) has studied the food habits of ungulates in Kedarnath Musk Deer Sanctuary by faecal analysis.

During the months of November and December 1992 and January 1993 we studied the food plants of Sambar, Gaur and Cattle in Periyar Tiger Reserve, Kerala. The objectives of this study were : (a) To identify the plant species eaten by Sambar, Gaur and Cattle in Periyar Tiger Reserve; (b) To know the proportion of grasses, herbs, shrubs and tree leaves in the died of Samber, Gaur and Cattle; and (c) To find out the dietary overlap if any among these ungulates.

Study Area

Study was conducted in the tourist zone (about 36 km) of Periyar Tiger Reserve. The biotope of the area is of moist deciduous type.

Methods

Epidermal characteristics of all possible food plants including grasses, herbs and shrubs were studied by methods adopted by Hansen (1971), Todd and Hansen (1973) and Hansen and Reid (1975) by taking section of upper and lower epidermis of leaves. Sections were mounted on microslides and camera lucida drawings are made. A key was thus prepared for all possible food plants of the reserve. In the second step the faecal matter of Samber, Gaur and Cattle were collected from the field, brought to the laboratory washed well and preserved in 5% formaline. The leaf fragments in these samples were compared with the key prepared for identification. The results were compared with field observations to confirm our findings of faecal matter analysis.

Results and Discussions

Food plants od Sambar : Sambar in total took 31 plants species, of which 22 were grasses, 3 species of shrubs and 5 herbs. *Emblica officinalis*, is the species where fruits were eaten (Table 1).

The study showed that of the total

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1. Field Director (Project Tiger)
2. Wildlife Preservation Officer
3. Data Collector
4. Research Officer

plant species, 70.9% were grasses and 29.1% non-grasses. *Garnotia arundinacea* and *Panicum repens* seem to be the most preferred food plant of Sambar.

Table 1

List of plants eaten by Sambar

Grasses

1. *Pennisetum hohenackeri*
2. *Garnotia arundinacea**
3. *Setaria intermedia*
4. *Dinebra retroflexa*
5. *Eragrostis bifaria*
6. *Cyrtococcum oxyphyllum*
7. *Cynodon dactylon*
8. *Apocopis wightii*
9. *Oplismenus compositus*
10. *Heteropogon contortus*
11. *Manisuris granularis*
12. *Cymbopogon contortus*
13. *Paspalum copactum*
14. *Digitaria sanguinalis*
15. *Panicum repens**
16. *Oryza granulata*
17. *Chrysopogon orientalis*
18. *Saccharum spontaneum*
19. *Themeda triandra*
20. *Rottboellia exaltata*
21. *Eleucine indica*
22. *Paspalum conjugatum*

Herbs

1. *Urena sinuata*
2. *Hibiscus lobatus*
3. *Ageratum conyzoides*
4. *Flemingea strobilifera*
5. *Urena lobata*

Shrubs

1. *Helicteres isora*
2. *Solanum torvum*
3. *Maesa perrottetiana*

Trees

Emblica officinalis

* Food plants mostly eaten during the period.

Food plants of Gaur : Gaur used 23 species of plants. Among these 21 were grasses, one herb and one shrub (Table 2).

Here the percentage of grasses over other plants was far exceeding when compared to Sambar. Ninetyone per cent of the recorded plant species were grasses and the rest herbs and shrubs. The major species eaten by Gaur are *Garnotia arundinacea*, *Setaria intermedia* and *Apocopis wightii*.

Table 2

List of Plants Eaten by Gaur

Grasses

1. *Setaria intermedia*
2. *Pennisetum hohenackeri*
3. *Heteropogon contortus*
4. *Chrysopogon orientalis*
5. *Oplismenus compositus*
6. *Saccharum spontaneum*
7. *Themeda triandra*
8. *Rottboellia exaltata*
9. *Imperata cylindrica*
10. *Garnotia arundinacea*
11. *Eleusine indica*
12. *Panicum repens*
13. *Panicum javanicum*
14. *Manisuris granularis*
15. *Eragrostis bifaria*
16. *Dinebra retroflexa*
17. *Panicum trypheron*
18. *Cymbopogon confertiflorus*
19. *Apocopis wightii*
20. *Digitaria sanguinalis*
21. *Cynodon dactylon*

Herbs

Flemingea strobilifera

Shrubs

Helicteres isora

* Food plants mostly eaten during this period.

Food plants of Cattle : Twenty three food plants were identified for domestic cattle.

Of these, 19 were grasses, 2 herbs and 2 shrubs. The list of food plants of cattle is given in Table 3. *Garnotia arundinacea*, *Panicum repens* and *Paspalum compactum* are the species mostly consumed by cattle.

Table 3

List of plants eaten by domestic Cattle

Grasses

1. *Cynodon dactylon*
2. *Cyrtococcum muricatum*
3. *Eleusine indica*
4. *Oplismenus compositus*
5. *Panicum repens*
6. *Paspalum conjugatum*
7. *Dinebra retroflexa*
8. *Garnotia arundinacea*
9. *Imperata cylindrica*
10. *Manisuris granularis*
11. *Paspalum compactum*
12. *Pennisetum hohenackeri*
13. *Rottboellia exaltata*
14. *Setaria intermedia*
15. *Themeda triandra*
16. *Alloteropsis cimicina*
17. *Apluda aristata*
18. *Digitaria sanguinalis*
19. *Oplismenus burmannii*

Herbs

1. *Sida longifolia*
2. *Urena sinuata*

Shrubs

1. *Helicteres isora*
2. *Solanum torvum*

* Food plants eaten during this period.

The results of this study show mostly grasses is the food of Sambar, Gaur and Cattle. The lesser number of non-grasses may be due to the fact, that the grass fragments took more time for digestion than non-grasses because of the presence of silica content. The differential rate of digestion of different plants was reported by Dearden *et al.* (1975) also.

Analysis of gross dietary profile suggests dietary overlap among the three animals namely Sambar, Gaur and Cattle in Periyar. There is 35.2% overlap between Sambar and Gaur, 31.5% between Sambar and Cattle and 30.4% in the case of Gaur and Cattle (Table 4). *Garnotia arundinacea* seem to be the most preferred food of Sambar, Gaur, and Cattle in Periyar during winter months.

Table 4

Types of plants in the diet of Sambar, Gaur and Cattle

Classes of plants	Classes of plants in (%)		
	Sambar	Gaur	Cattle
Grass	70.9	91.4	82.6
Herb	16.2	4.3	8.7
Shrub	9.6	4.3	8.7
Tree	3.3	0	0

Conclusions

The study, though of a short term duration, reveals that in the diet of Sambar, Gaur and Cattle grasses dominated over browse. There is considerable overlap of food plants among the three animals, and too much grazing by domestic cattle may lead to food scarcity in the study area. But clearcut conclusions can be made only after carrying out a long term study, at least for two more years.

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Our sincere thanks are due to Dr. J.F. Bendell, Professor of Wildlife, University of Toronto, Ontario, Canada for his guidance, suggestions and help in carrying out this work.

SUMMARY

The studies on the food plants of Sambar, Gaur and Cattle conducted in the Periyar Tiger Reserve, Thekkady, Kerala have been described in this paper.

पेरियर बाघ आरक्षित क्षेत्र में सदियों से सांभर, गौर और गाय बैलों की भोजन की आदतों का औतिकीय अध्ययन

के०के० श्रीवास्तव, ए०के० भारद्वाज, सोनी जार्ज व वी०जे० जकरियास

सारांश

पेरियर बाघ आरक्षित क्षेत्र, ठेक्काडी, केरल के सांभर, गौर और गाय-बैलों की भोजन आदतों पर किये गये अध्ययन को प्रस्तुत अभिपत्र मे वर्णित किया गया है ।

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INFLUENCE OF DEER ON THE ARTIFICIAL REGENERATION IN THE MANGROVE OF SUNDARBANS, BANGLADESH

N.A. SIDDIQI

Bangladesh Forest Research Institute, Chittagong (Bangladesh)

Introduction

The Sundarbans is the largest continuous mangrove forest of the world. The forest within Bangladesh territory, covering an area of about 6000 km² (remaining 4000 km² in India), lies between the latitudes 21°31' and 22° 30' N and between the longitudes 89° and 90° E. The merchantable growing stock of both the dominant species of the forest, *Heritiera fomes* and *Excoecaria agallocha* has been depleted by 40 and 45 per cent respectively over a period of about 25 years (Chaffey *et al.*, 1985). A number of steps including artificial regeneration would assist in improving the stocking. Seedling availability in the forest floor was sufficient (27,750 seedlings/ha/year), but failure of the seedlings to survive and establish themselves was a major problem for ensuring a rich stocking (Siddiqi, 1984).

Various factors, both abiotic and biotic, affect successful establishment of mangrove regeneration. Among the biotic factors, the Spotted Deer *(Axis axis)* plays an important role in the regeneration of Sundarbans (Champion *et al.*, 1965; Blasco, 1977; Anon., 1982; Salter, 1984; Siddiqi and Husain, 1984). In raising trial plantations, the deer was found to be a problem (Siddiqi, 1986). So, the need to study the impact of Deer on artificial regeneration was felt.

Materials and Methods

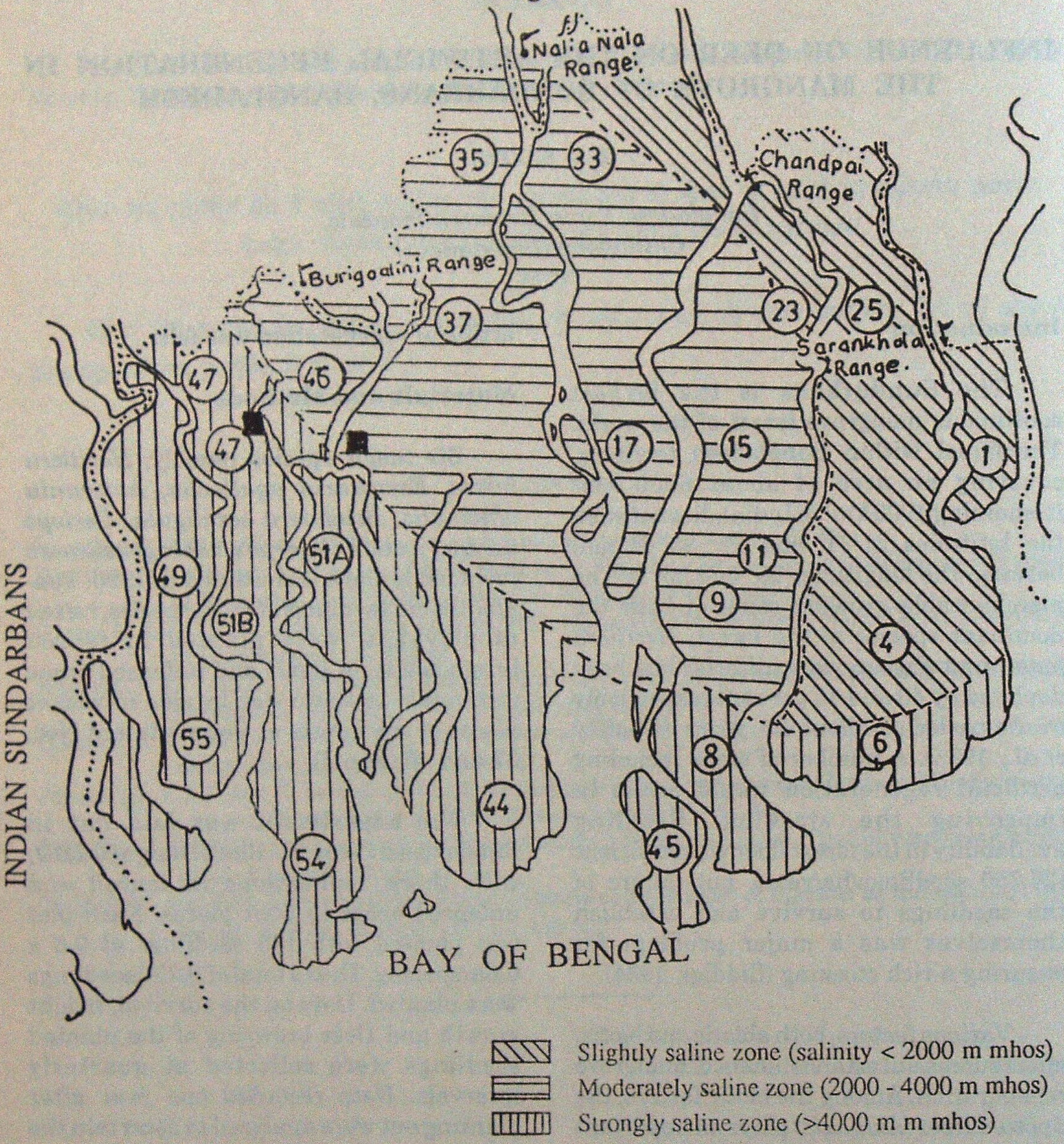
Six major species namely, *Heritiera fomes, Excoecaria agallocha, Avicennia officinalis, Bruguiera sexangula, Ceriops decandra* and *Xylocarpus mekongensis* were included in the trial initiated in 1990. Ten-months old seedlings of these species, raised in polybags, were planted in fenced (protected from Deer) and unfenced areas (accessible to Deer) side by side in vacant places of the forests at Compartment Nos. 37 and 46 (Fig. 1).

The experiment was laid out in Randomised Complete Block Design (RCBD) with there replications in fenced and unfenced areas in both places. Each plot was planted with 135 seedlings at 0.6 x 0.6m spacing. Thus a total of 9,720 seedlings were planted. Data on the survival, height growth and Deer browsing of the planted seedlings were collected at quarterly intervals. Data recorded one year after planting out were analysed to ascertain the magnitude of damage to the plantations.

Results

A considerable proportion of seedlings was damaged by Deer in the unfenced plots.

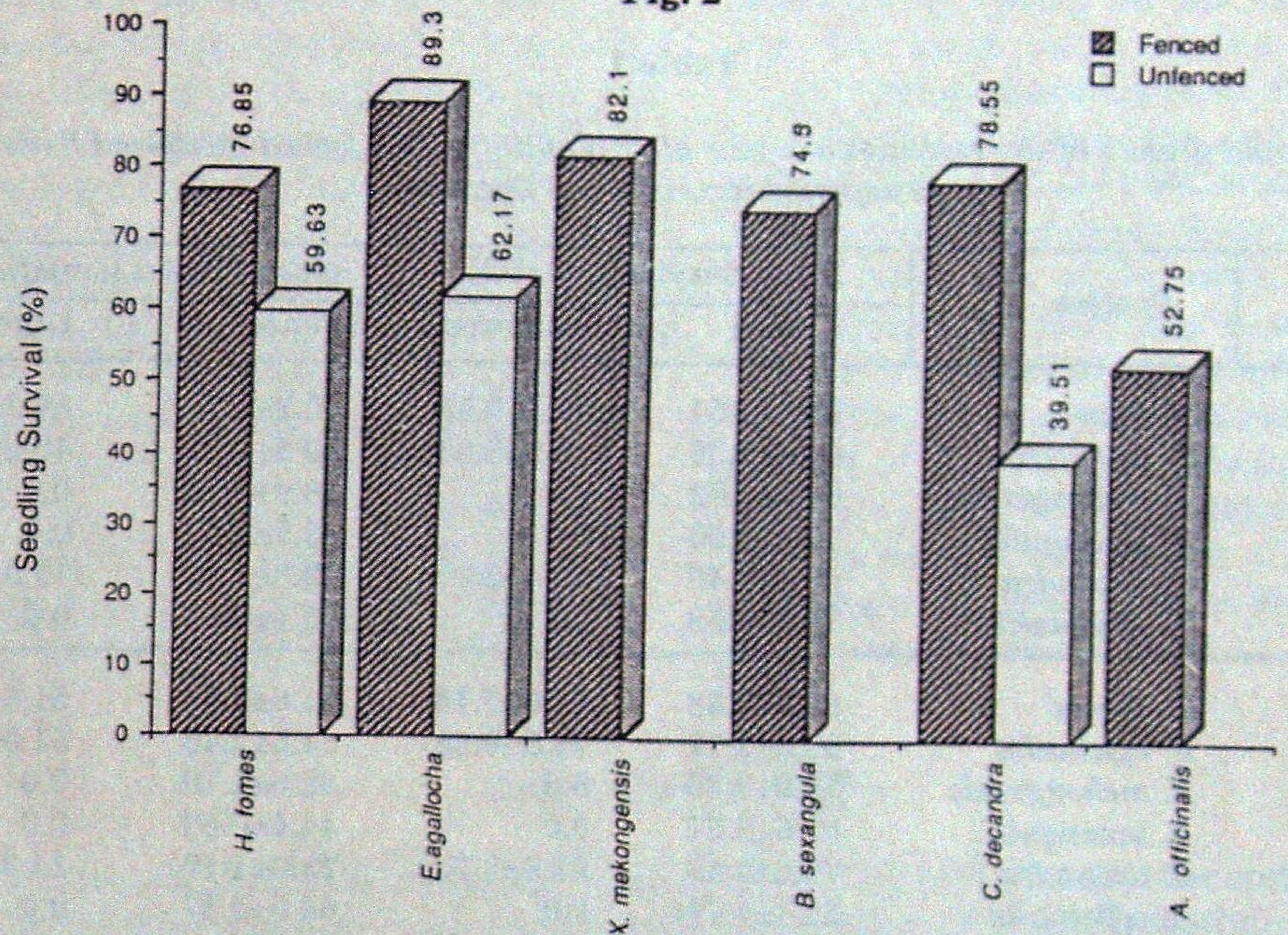
Fig. 1



Map of the Sundarbans showing the locations (■) of the experimental plantations

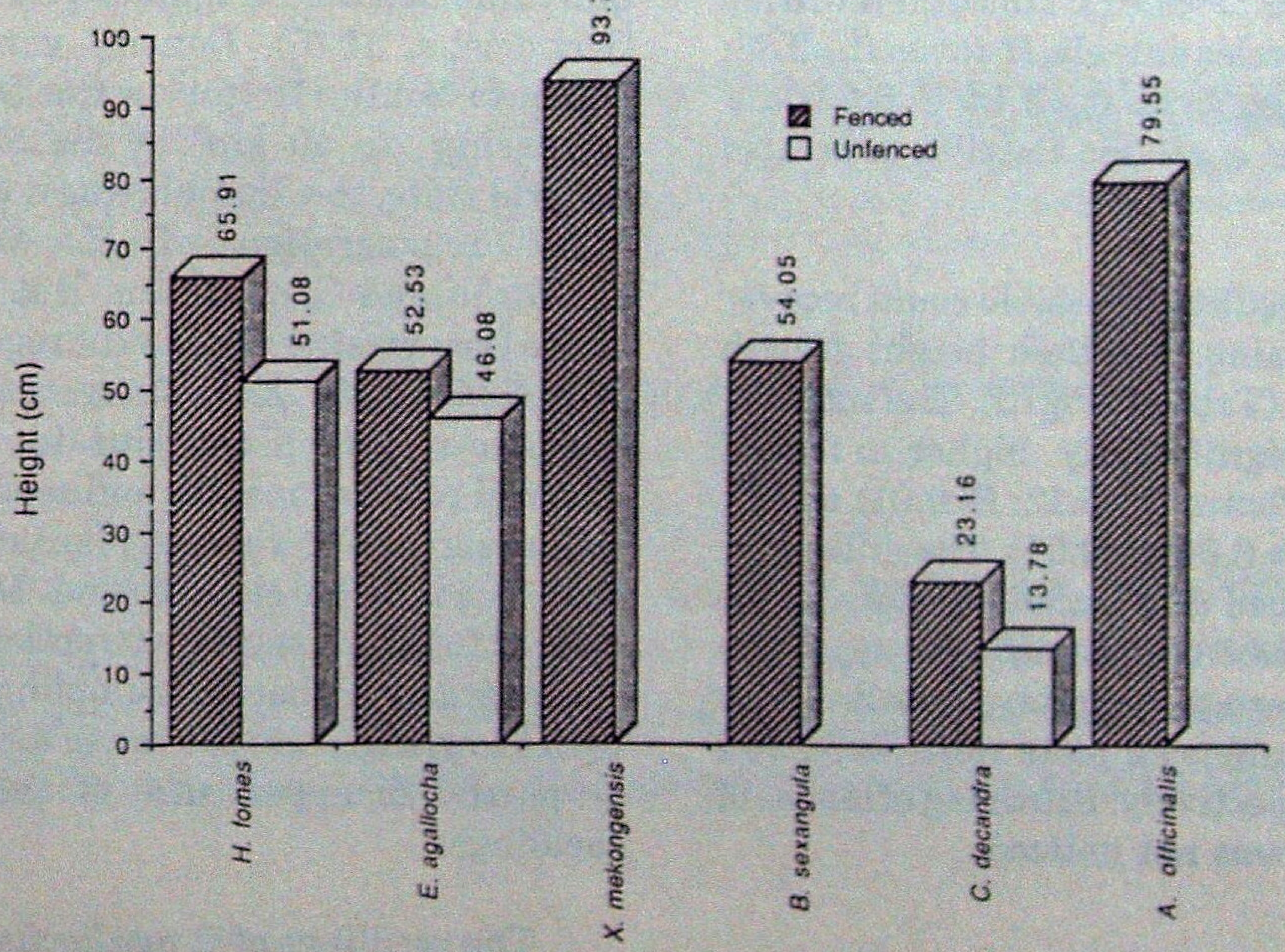
In both the places (Compt. Nos. 37 and 46). all the planted seedlings of *X. mekongensis*, *B. sexangula* and *A. officinalis* died in the unfenced plots (Table 1, Fig. 2). The intensity of browsing was so severe that virtually all the seedlings died within only two months after out-planting. The difference in seedlings survival between fenced and

Fig. 2



Average survivals of six species planted in fenced and unfenced plots

Fig. 3



Averge heights of six species planted in fenced and unfenced plots

Table 1

Survival and growth of the seedlings one year after planting in the fenced (protected from Deer) and unfenced (accessible to Deer) plots

Location	Species	Mean Survival (%)±S.E.		Mean Height (cm)±S.E.	
		Fenced	Unfenced	Fenced	Unfenced
Comptt. No. 37	*H. fomes*	73.5±3.51	55.3±8.53	70.2±1.30	50.6±3.47
	E. agallocha	85.4±1.35	48.9±8.63	50.5±1.91	40.6±3.13
	X. mekongensis	85.2±1.72	0.0	98.9±4.72	0.0
	B. sexangula	79.4±0.00	0.0	63.7±2.21	0.0
	C. decandra	86.5±2.40	51.4±23.73	23.3±1.36	13.3±1.26
	A. officinalis	74.1±5.59	0.0	95.1±8.82	0.0
Comptt. No. 46	*H. fomes*	80.2±4.38	64.0±7.18	61.6±2.54	51.5±1.78
	E. agallocha	93.2±2.17	75.5±9.86	54.6±2.46	51.5±1.53
	X. mekongensis	79.0±3.89	0.0	88.6±1.70	0.0
	B. sexangula	69.6±2.57	0.0	44.4±0.60	0.0
	C. decandra	70.6±4.48	27.6±3.71	23.0±1.10	14.3±0.96
	A. officinalis	31.4±4.74	0.0	64.0±2.87	0.0

unfenced plots was significant ($F_{1},60=214.09$; $P<0.01$). This difference for individual species namely, *H. fomes* ($t_5=2.83$; $P<0.05$), *E. agallocha* ($t_5=3.14$; $P<0.05$) and *C. decandra* ($t_5=2.88$; $P<0.05$) was also significant.

Some seedlings possible could recover partial browsing. But their height growth was affected (Table 1, Fig. 3). The seedling height was significantly higher in fenced plots for *H. fomes* ($t_5=5.12$; $P<0.01$) and *C. decandra* ($t_5= 8.86$; $P<0.01$). The difference between fenced and unfenced plots for *E. agallocha* was non-significant ($t_5=1.92$) although average heights of seedlings in fenced and unfenced plots were 52.53 and 56.08 cm respectively. Browsing of leaves of this species was not noticed.

Discussion

The Spotted Deer (*Axis axis*) has roughly a population size of 80,000 individuals in the Bangladesh Sundarbans (Hendrichs, 1975). Density varied from North to South (10 km² in the North and increasing to 40 km² in the South). In natural state, the animals was not found to affect regeneration of *H. fomes, E. agallocha* and *C. decandra*. But browsing by the Deer was harmful for the regeneration of *A. officinalis, X. mekongensis* and *B. sexangula* (Siddiqi and Husain, 1984). In the trial plantations, the influence of Deer was greater. For raising plantations, the sites used to be cleared and Deer were noticed to have a special attraction for such site for grazing in herds. Trampling, together with browsing, were the cause for complete or partial disappearance of the planted seedlings.

The seedlings of *E. agallocha* were not found to be browsed in the experimental plots. Light browsing of young leaves of *H.*

fomes and *C. decandra* was noticed. Deer had a preferential browsing habit. It appears for the study that *E. agallocha* can be included as a suitable species for artificial regeneration when damage caused by Deer is taken into consideration. Further investigation on the inclusion of *H. fomes* and *C. decandra* for artificial regeneration is necessary. Species like *X. mekongensis*, *B. sexangula* and *A. officinalis* could only be raised in fenced areas protected from Deer. But fencing is not practically and economically feasible for large scale planting. Troup (1921) reported that in the mangrove of Myanmar, the Hog Deer (*Axis porcinus*). by eating off the main shoots, was the main cuase of the failure of experimental plantations of *Rhizophora mucronata*, *R. apiculata* and *Kandelia candel*. Chai and Lai (1984) suspected that many hypocotyls of newly planted seedlings in the mangrove of Sarawak (Malaysia) were broken off near the base by Deer. Siddiqi *et al.* (1984) reported that in a established mangrove plantation in Bhola District of Bangladesh, raising a second rotation crop with species like *X. mekongensis*, *B. sexangula*, *C. decandra* and *Aegiceras corniculatum* was difficult due to introduction of Deer.

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SUMMARY

Studies made on the scope of artificial regeneration in the mangrove of Sundarbans, Bangladesh showed uncertain prospect due to browsing of the panted seedlings by the Spotted Deer (*Axis axis*). The Deer had a significant detrimental effect on the regeneration of *Heritiera fomes*, *Xylocarpus mekongensis*, *Bruguiera sexangula*, *Ceriops decandra* and *Avicennia officinalis*. Only *Excoecaria agâllocha* was found to overcome the influence of Deer browsing to a large extent.

सुन्दरबन, बंगलादेश में वायुशिफों के कृत्रिम पुनर्जनन पर हिरणों का प्रभाव

एन०ए० सिद्दीकी

सारांश

सुन्दरबन, बंगलादेश में वायुशिफों के कृत्रिम पुनर्जनन क्षेत्र में किए गए अध्ययनों ने उनकी अनिश्चित संभावनाओं को दिखाया क्योंकि उनमें रोपे गए पौधों को चीतल (*एक्सिस एक्सिस*) चर जाते है । हिरणों का *हेरिटियेरा फोमेस*, *जायलोकार्पस मेंकोंगनेंसिस*, *ब्रुगुयेरा सेक्सेंगुला*, *सेरियोप्स डिकेण्ड्रा* और *एविसीनिया औफिसिनेलिस* के पुनर्जनन पर बहुत हानिकारक प्रभाव पड़ता रहा है । केवल *एक्सकीकेरिया अगालोचा* ही काफी अधिक सीमा तक हिरणों द्वारा चरे जाने के प्रभाव से पार पाता पाया गया ।

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OF CONSERVATION AND CONSERVATISM

RAKESH SHUKLA*

Introduction

There is absolutely no need to go into the complexities of the well established "whys" of the philosophy of wildlife conservation in the country. Instead, we must now concern ourselves with the "hows" of this philosophy. Despite the fact that wildlife conservation is regarded as a rather newly explored consciousness in the Indian psyche, and the wildlife managers have often risen to the occasion by putting in their sheer competence in various conservation projects, and winning international acclaim, they have, all along, been the targets of criticism from various quarters. What sometimes the media prints/presents is unfounded, unresearched and often distorted versions of information on conservation efforts. Many of the retired government conservationists are also known to be aligned with the NGOs and have almost overnight acquired a surprisingly new perception of wildlife conservation. And the most unfortunate aspect of the total scenario is that instead of pointing out the "conformities" of the System, they pick on the persons of their own choice involved in the conservation efforts.

There is no denying the fact that it was the developed countries which initiated India into conservation strategies and provided it with the much needed funds and expertise in various forms. Now that the country has gained so much experience, why, then, all this scepticism about conservation efforts reaching a plateau? It seems that the conservation efforts proved to be very effective and brought tremendous success at the initial stages, but later a typical conservation attitude of the whole System overrode the zeal and spirit of the mission. What conservatism here implies is the lack of ruthless convictions with which a system should have been reviewed and revamped over all these preceeding years to ensure consistent success.

In retrospect we may identify some inbuilt factors working against the spirit of wildlife conservation.

Fatigued Infrastructure

Assuming the early seventies as the beginning of the serious wildlife conservation efforts, the preceeding era has witnessed the prime of a generation's life at the untiring toil to ensure the desired success. The old guard now seems exhausted and spent, looking to the younger lot to take charge. Once on the wrong side of 48, or say, 50, with pressing personal and familial preoccupations, they all more or less call it a day. Therefore frequent recruitments of the younger lot for timely replacement of the seniors, and for learning the basics of conservation from the remaining ones ensure that no vaccum of expertise is created, and at the same time the infrastructure remains young and dynamic. Long spells of

* Range Forest Officer, Kanha Tiger Reserve, Mandla (Madhya Pradesh)

isolation from the family also seem to take their psychological toll, sometimes leading to emotional disorders causing distractions from normal duties.

Neglected Incentives

It is a fact that park services are often more demanding, frighteningly isolated and more difficultly recognisable than those in the other branches of forestry. There is a popular notion that these are a dumping place for the "rejected" and the "dejected". Hard service conditions and such express opinions ensure that there is no competition to serve in the wildlife wing. Furthermore, there is an appalling lack of incentives of any shape or form to boost the morale of the managers and get the best out of them. Sometimes the amount they get as "special pay" is so meagre as to be rather humiliating to them. Such incentive should be in the form of a "real" special pay (at least Rs. 400/- in the case of a Forest Guard) and that too in the descending order for the higher ups, and opportunity of early promotions. There are some more facilities which can be extended to the remotely stationed manager supposed to be shouldering the responsibility of "triple establishments" by say, providing his children with a hostel for their education at a district place.

Tardy Judicial Proceedings

Wildlife managers have no practical training in the investigation of wildlife offences which is often tedious, time consuming and calls for a plethora of formalties before the case is considered fit for submitting to the court. Such expertise is always known to be gained by experience rather than by any special crash courses for the managers. The offences investigated in such manner and produced to the court are often so technically fragile that they cannot stand the legal battle, and the offender goes scot free making a mockery of both the law and the managers.

This is a well known fact that our judiciary is overburdened with a huge backlog, and this results in slow judicial proceedings of wildlife offences, often taking, on an average, 5 to 10 years in a trial of Tiger poaching, to give the verdict. This lengthy judicial proceeding adversely affects the case in so many ways and provides the offender a "psychological relief", and often the prosecution itself suffers the agony of the "justice delayed is justice denied".

Now it no longer remains a far-fetched concept to seriously consider the possibility of forming mobile courts, to start with one in two or three districts, exclusively for forest/wildlife offences. It will not only reflect the government's sincere commitments to wildlife conservation, it will also put the offenders, in particular, under immense psychological pressure, and the public, in general, in the sheer awe of the law.

The "Indispensability" Syndrome

This is a most unfortunate phenomenon which gradually creeps into any conservation organisation where timely recruitments and proper substitutions have to take a back seat. Though there is no substitute for experience, senior managers often become prone to acquiring this syndrome, resulting in non-coordination confusion and ego problems, and the ultimate casualty is excellence. This also creates uncalled for "dependence" on the "indispensables" and conservation efforts are bound to lose their desired effectiveness. The top brass of such organisations often have difficult times dealing with the matters

which hardly merit their attention. Such static infrastructure gives rise to frequent uncalled for retrospection for references, and the present leadership finds it very difficult to introduce and implement any new strategy for conservation.

Protocolized Tourism

Oflate a frustratingly large percentage of tourism pressure in most of the wildlife reserves has become highly protocolized often putting the managers in constant attendance upon the VIPs. Such frequent and long protocolized preoccupations not only affect the normal conservation duties, they often tend to prevail over the spirit of conservation. Highlighting the problems such tourism pressure causes, efforts must be made by frequently sending appeals to all the ministries and departments, requesting the "target people" to remain satisfied with the services of a protocol officer and his team, and not make mandatory the presence of wildlife manager for the sake of effective conservation. This readjustment in the attitude of the "target people" will also serve the cause of wildlife conservation.

Arbitrary Personnel Management

Faulty management of personnel is sometimes known to give a serious blow to the conservation efforts. Trained wildlife managers interested to continue in the wildlife wing are often transferred outside in a fairly arbitrary manner. Others are "punished" and find themselves posted to some unit of wildlife conservation. All this is done in the interest of "administration" with hardly any regard for the opinions of those at the helm of affairs, and such practices leave a serious question mark to the commitments to wildlife conservation. It is very important that there must be effective coordination at some higher level to at least minimize the number of such instances that might undermine conservation priorities.

SUMMARY

The paper deals with the prevalent conservatism seriously affecting wildlife conservation in the country. Despite the fact that wildlife conservation was a great success at the initial stages, serious questions are now being raised about it. A critical analysis has been done to identify the inbuilt factors in the System which are undermining the conservation efforts. These factors include - fatigued infrastructure, neglected incentives, tardy judicial proceedings, the "indispensability" syndrome, protocolized tourism and arbitrary personnel management.

संरक्षण एवं रुढ़िवादिता के संदर्भ में

राकेश शुक्ला

सारांश

इस लेख में वन्यप्राणी संरक्षण को गंभीर रूप से प्रभावित कर रही रूढ़िवादिता के बारे में बताया गया है । प्रारम्भिक चरणों में वन्यप्राणी संरक्षण में इतनी सफलता अर्जित करने के बावजूद भी आजकल संरक्षण की सफलता को लेकर गंभीर प्रश्न उठाये जा रहे हैं । इस बात का विश्लेषण किया गया है ताकि तंत्र में स्थित उन कारकों को पहचाना जाये जो कि संरक्षण प्रयासों को कमजोर कर रहे हैं। ये कारक है : थका हुआ तत्रं, उपेक्षित उत्साह वर्धन, धीमी न्यायायिक प्रक्रिया, "स्वतो महत्वपूर्ण" लक्षगों का समावेश, अति औपचारिक पर्यटन एवं त्रुटिपूर्ण मानव प्रबंधन ।

SOME OBSERVATIONS ON TROOP STRUCTURE, ACTIVITY BUDGET AND FOOD HABITS OF THE NILGIRI LANGUR (*PRESBYTIS JOHNII*) IN PERIYAR DURING MONSOON (JUNE - AUGUST)

K.K. SRIVASTAVA[1], V.J. ZACHARIAS[2], A.K. BHARDWAJ[3], PETRISIA JOSEPH[4] AND SHERLY JOSEPH[5]

Periyar Tiger Reserve, Thekkady (Kerala)

Introduction

Nilgiri Langur, *Presbytis johnii*, is an endemic species to the Western Ghat. It once enjoyed a wide distribution in the Southern-Western Ghats, but has become an endangered species now, due to hunting, habitat destruction and conversion of forest lands. The false belief about the medicinal value of its meat led to a fast decline in the number of this species.

Some studies on the ecology and social behaviour of the Nilgiri Langur were done by Poirier (1968 a, 1968 b, 1969, 1970a, 1970 b) in the Annamalais. Kurup (1975) has described the status of the species in the Annamalai, Cardamom Hills and Nilgiri Hills. Some studies on the home range, territory and the food of Nilgiri Langur in Periyar were done by Tanaka (1965) and Horwich (1972). A detailed information on the composition of its troop, behaviour pattern and seasonal variations in food habits were still lacking.

A study of the Nilgiri Langur in Periyar was started in 1992 June with a view, to compare the troop size, territory size and food habits of the species here, with previous studies and to find out changes if any occurred over the last 20 years. This paper describes the activity budgets and food habits of Nilgiri Langur in the tourism zone of Periyar Tiger Reserve in the monsoon season over a period of two years (1992-93).

Study Area and Methods

Intensive studies were centered in and around the tourism zone of the Periyar Tiger Reserve, as the troops are slightly habituated to human beings here. When the study was started, the Langurs were weary and cautious about the observer. It took about 2 months for them to become familiarised with the presence of the observer.

Monthly observations through fixed transects were done at Thannikkudy, Mullakkudy and Pachakkanam to estimate population. Some studies were also conducted on the nutrient value of various food taken by the species. Troops were followed from 8.00 A.M. in the morning till 6.00 P.M. in the evening and observed with binoculars. Observations were carried out on 5 troops at this area. Two troops had identifiable individuals with them, a female with a stumped tail in one troop and another female with a paralysed leg in another

1. Field Director (Project Tiger)
2. Research Officer
3. Wildlife Preservation Officer
4 and 5. Data Collectors

troop. These troops were selected for intensive study. Composition of the troop with regard to age, sex and changes taking place due to natality, mortality, emigration and immigration were recorded.

Time budget study was conducted on these two groups. On days, when observations were temporarily discontinued, the troops could usually be found again and observations resumed. Food and feeding habits were recorded along with the phenology of the plants in the area. Food plants were identified directly, while the troop was feeding and by collecting fragments of leaves and fruits fallen on the ground.

Results

Distribution and Troop size : The Nilgiri Langur enjoyed a side distribution in Periyar. A total of 178 troops were observed in the reserve, there estimated population of the species is 1100. Five troops and a lone male were observed in the tourist zone.

Table 1

Activity Budget of adult females of the two troops of Nilgiri Langur during monsoon season (in minutes)

Date	Fe	Dr	Gr	Agr	Pl	Re	Mov	Mo	Ru	Ju	Ch	Fi	Wa	Agg	Mia
June	2700	-	600	1140	-	3900	540	-	180	120	-	-	240	720	-
July	2940	-	240	300	-	3240	420	-	90	60	-	-	120	600	30
August	3120	-	360	480	-	3540	600	-	90	30	-	-	240	660	60
Total	8760	-	1200	1920	-	10680	1560	-	360	210	-	-	600	1980	90
Mean Valve	2920		400	640	-	3560	520	-	120	70	-	-	200	660	30

Table 2

Activity Budget of the adult males of the two troops of Nilgiri Langur during monsoon season (in minutes)

Date	Fe	Dr	Gr	Agr	Pl	Re	Mov	Mo	Ru	Ju	Ch	Fi	Wa	Agg	Mia
June	4140	-	1140	1020	130	2220	480	-	240	120	180	300	60	60	-
July	3600	-	660	420	-	1440	420	-	420	300	360	240	120	120	-
August	3660	-	900	540	-	1860	600	-	480	300	240	360	240	60	-
Total	11400	-	2700	1980	-	5520	1500	-	1140	720	780	900	420	240	-
Mean Value	3800	-	900	660		1840	500	-	380	240	260	300	110	80	-

Abbreviations : Fe - Feeding, Dr - Drinking, Gr - Grooming, Agr - Allogrooming, Pl - Playing, Re - Resting, Mov - Movement, Mo - mounting, Ru - Running, Ju - Jumping, Ch - Chasing, Fi - Fighting, Wa - Watching, Mia - Mother infant association.

Troop size varied from 8 to 32 the study area.

Activity patterns : There is a clear difference in the duration of the time spent by individuals of different age class in a troop. From the observations of the different class members of the two troops, the pattern of daily activities, like feeding, drinking, grooming, allogrooming, playing, resting, movement, mounting, running, jumping, chasing, fighting, watching, aggression, mother infant association and infant sucking milk has been documented. Analysis of the data showed that adult female spent more time for resting than feeding in monsoon (Table 1). But adult male spent more time for feeding, offence, defence and grooming (Table 2). Adult male spend 11400 minutes (190 hrs) out of 456 hrs for feeding, offense and defence, while adult females spend only 143 hrs for feeding and used more time for resting and parental care.

Food : The food of the Nilgiri Langur in the monsoon season consisted of fruits, nuts, buds, leaves and barks of different trees (Table 3). During rainy season it consumed mostly the tender leaves of *Tectona grandis, Terminalia paniculata, Pterocarpus marsupium.* But during winter season, it used fruits and flowers of the same plants. The Table 3 shows the different types of food plants of Nilgiri Langur during the monsoon season. They took fruits and seeds of 19 tree species and tender leaves of 3 tree species during this period. Competition for food was not observed between the Nilgiri Langur and Giant Squirrel as they were observed feeding on the same tree together. But the Langur is afraid of the Bonnet macaque and on the arrival of the latter in the feeding place, the Langur troops moved away.

Table 3

Food plants of Nilgiri Langur in Periyar in the monsoon season (June-Sep.)

Name of Plant	Part eaten
Tectona grandis	Midrib of leaf
Artocarpus hirsuta	Fruits
Enteda scandens	Tender leaf
Evodia lunu ankenda	Fruits
Actinodaphne hirsuta	Fruits
Terminalia paniculata	Tender leaf
Pterocarpus marsupium	Tender leaf
Grewia tiliaefolia	Fruits
Loranthus tomentosus	Flowers
Dalbergia latifolia	Tender leaf
Lepisanthes erecta	Fruits
Cordia obliqua	Seed
Gloriosa superba	Tender leaf
Myristica dactyloides	Seeds
Mallotus tetracoccus	Leaf buds
Hydnocarpus alpina	Seeds
Clausena indica	Fruits
Spondias pinnata	Fruits
Psidium guajava	Fruits
Memecylon malabarica	Fruits
Casearia esculenta	Fruits
Schefflera spp.	Fruits
Maesa perrottetiana	Fruits
Tabernaemontana dichotoma	Seeds
Ehretia canarensis	Flower & Fruits
Vitex altissima	Flower & Fruits
Litsea laevigata	Fruits
Fiscus callosa	Fruits
F. mysorensis	Fruits

Troop structure : Proportion of individuals (age and sex) in two groups observed during this period is given in Table 4. Sex ratio was in favour of females. Adult females formed about a third of the total number. No significant change was observed in the composition of two groups over a period of

Table 1

Troop structure in two troops of Nilgiri Langur in Periyar

1992	Adults		Subadults		Inf-ants	Juv-enile	Total	1993	Adults		Subadults		Inf-ants	Juv-enile	Total
	M	F	M	F					M	F	M	F			
Troop I :															
June	2	7	4	2	3	1	19	June	2	7	5	2	4	1	21
July	2	7	4	2	3	1	19	July	2	7	5	2	4	2	22
August	2	7	4	2	4	1	20	August	2	7	6	2	5	1	23
Troop II :															
June	3	5	5	1	4	1	19	June	4	6	7	-	3	2	22
July	3	5	5	1	4	1	19	July	4	6	7	-	3	2	22
August	3	5	6	1	4	1	20	August	4	6	7	-	3	3	23

M - Male ; F - Female

one year. One young was borne during this period in the two groups observed. No mortality was recorded in the two troops observed, during this period.

Discussion

Activity pattern of adult individuals in a Nilgiri Langur troop was studied during monsoon months in 1992 and 1993 during day time. Results show that adult male spent more time for feeding, offence, defence and grooming activities, while the female spent more time for resting than feeding. This may be related to their peak breeding season. The Nilgiri Langur took mostly fruits of trees during monsoon though they took tender leaves of certain species of trees. Adult females formed about a third of a troop. No significant change was noted in the composition of a troop in an year.

SUMMARY

To compare the troop and territory sizes, food habits and activity budgets of Nilgiri Langur in Periyar Tiger Reserves in monsoon seasons, a study was conducted and results are summarized.

पेरियर में मानसून के समय (जून से अगस्त) नीलगिरी लंगूरों (प्रेसबायटिस जोहनाई) की दल रचना, कार्य कलाप और भोजन आदतों विषयक कुछ पर्यवेक्षण

के०के० श्रीवास्तव, वी०जे० जकरियास, ए०के० भारद्वाज, पेट्रीशिया जोजफ व शरले जोजफ

सारांश

पेरियार बाघ आरक्षित क्षेत्र के नीलगिरी लँगूरों के मानसून मौसम में दल और प्रदेश के आकार, भोजन की आदतों और कार्यो का अध्ययन किया गया था जिसके परिणामों का सार इस अभिपत्र में दिया गया है ।

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TACKLING THE PROBLEM OF BLACKBUCKS IN BUSTARD SANCTUARY, KARERA

R.D. SHARMA*

Introduction

The Bustard Sanctuary, Karera established for the conservation of The Great Indian Bustard (*Ardeotis nigriceps*) now has large population of Blackbucks as its main beneficiary. 202.21 km^2 of sanctuary area between Mahuar and Sindh rivers is without any forest land. Out of 202.21 km^2 of land 55.55 km^2 is revenue land and rest is owned by Bhumiswamis. There are 32 revenue villages inside the sanctuary area presently having a total human and cattle population of 33,156 and 42,907 respectively. Various cereal crops such as gram, wheat and jwar, pulses and vegetables are cultivated in patches segregated by wastelands. In the year 1981, when sanctuary was declared the number of Blackbucks was only 100 to 150. The number of Blackbucks estimated from 1984 onwards in given in Table 1.

Table 1

Year	Number of Blackbucks
1984	187
1985	306
1986	456
1987	765
1988	1169
1989	1923
1990	2138
1991	2626
1992	3005
1993	3777

Over-abundant population of Blackbuck has posed a serious problem for farmers as well as for bustard management. Started in the year 1985, the problem of crop raiding by Blackbucks has become very acute. An extensive survey made to assess the extent of damage to crops investigates that lentil (*Lens enculenta*) with 17.67 per cent damage is most damaged crop which is followed by mustard (*Brassica campestris*), taramira (*Eruca sativa*) and gram (*Cicer arietinum*) with 13.15, 12.69 and 12.10 per cent damage respectively. The wheat (*Triticum vulgare*) is least damaged crop with only 10.97 per cent damage (Sharma, 1989). The Blackbuck damage problem resulting from increase in number of Blackbucks has given rise to many factors inimical to bustard conservation (Sharma, 1994). Therefore, translocation of Blackbucks has been felt necessary and translocation trials have been attempted from time to time. Some relief measures have also been tried.

Translocation Trials

As there is a need to each and translocation Blackbucks to some suitable area like Madhav National Park, Shivpuri, various translocation trials have been conducted on experimental basis which are given as here under.

(1) In the year 1987, efforts were made to catch Blackbucks, using nylon nets (10 cm

* Superintendent, Pench Sanctuary, Seoni (Madhya Pradesh)

x 10 cm) which were 240 cm in height. These nets were spread over the affected area. Blackbucks were driven towards the net but no success achieved.

(2) In the year 1988, traditional catchers Mogia tribals which used to catch wild animals alive in the past were employed to catch Blackbuck alive. They tried to catch Blackbuck by using noose and were successful in catching one doe but due to shock this could not survive.and died on the same day. As a result, this experiment was also considered as a failure.

(3) To catch Blackbucks, experts from Kanha National Park, M.P. and Wildlife Institute of India, Dehra Dun were approached to tackle the problem. After having proper idea of the problem Wildlife Institute of India, Dehra Dun, in collaboration with U.S. Fish and Wildlife Service tried to catch Blackbucks during the course of workshop on "Wildlife Damage Problem and Control" organized at Madhav National Park, Shivpuri and The Great Indian Bustard Sanctuary, Karera from 2-7 Feb. 1994. They tried to catch Blackbucks using rocket, corral, drop net and drive net, nut no success achieved.

Relief Measures

In view of the repeated failures of the translocation trials in order to provide relief to farmers, some following measures have been tried to mitigate the problem of Blackbucks.

(1) In the year 1988-89 crop protection chowkidars were kept by sanctuary management from amongst the affected farmers to protect the crops from Blackbuck depredations. Five such chowkidars were kept in each of the 12 affected villages. Each chowkidar was given the duty to protect his crop along with those of 4-5 neighbouring affected farmers.

This practice was continued in the year 1989-90 also, but now every affected farmer wanted to be appointed as chowkidar and every farmers wanted to be included in the list of affected farmers. The farmers started complaining that chowkidar protects his crop only. In such a situation this practice did not work and had to be stopped.

(2) In order to give relief to farmers from Blackbuck depredation on their crops, gram *(Cicer arietinum)* was raised departmentally over an area of 11.5 ha, 19.00 ha and 8.1 ha in the year 1990-91, 1991-92 and 1992-93 respectively in the most affected areas i.e. Turkari and Berkhera for use by black bucks. Blackbucks were allowed to use this gram freely without chasing them away. As farmers chase them away from their crops, they were observed to use departmentally raised *Cicer arietinum* freely. They were visiting these fields in large numbers, sometimes more than 500 Blackbucks aggregated in these fields. This practice was found to be successful in providing relief to farmers.

Future Strategy

Based on the past experience, following measures, which will be helpful in minimising crop raiding by Blackbucks and also be beneficial to bustard management, are suggested as here under:

(i) The translocation of Blackbucks to other suitable areas is not possible. All the available methods to catch Black-blacks for translocation of Blackbucks to some other suitable area have been tried but all have resulted in failures. To minimise crop

damage, the maximum possible number of Blackbucks is proposed to be brought inside 3 m high enclosures constructed using chain link fence and G.I. pipes. Inside these enclosures, crops like gram (*Cicer arietinum*) should be raised for use of Blackbucks and drinking water facility should be provided Gram cultivation inside enclosures is also necessary for luring Blackbucks to come inside enclosures. Mahua flowers do not attract the Blackbucks of Karera probably because Mahua does not naturally occur in the area and they have never tested it. Mahua flowers brought from other sources were kept to lure them but it gave negative results. Six such enclosures are proposed to be constructed one each at Behgawan, Turkani, Karawwa, Silra, Kharicha and Berkhera. Each enclosure should not be less than 50 ha in area. For construction of these six enclosures acquisition of 300 ha of land is essential.

(ii) The practice of departmental cultivation of *Cicer arietinum* for use by Blackbucks should be continued as it has been unequivocally proved to be a successful relief measure to farmers. In winters, when insect population in low, gram (*Cicer arietinum*) and taramira (*Eruca sativa*) constitute the only palatable diet during winters. Thus this practice is beneficial to bustard also.

(iii) *Zizyphus rotundifolia* which is most remarkable feature of the fauna is in great danger. Its leaves are favourite food of Blackbuck. Heavy grazing pressure and its exploitation by villagers for fodder purposes are destroying this species. Growing of *Zizyphus* by seed sowing will help in maintaining this species which will be available for use by Blackbuck and help in minimiseing crop raiding by Blackbuck. As drupes of *Zizyphus* are included in the diet of bustard, it will be beneficial to bustard also.

(iv) *Carrying out Eco-developmental works* : As a result of damage to crops by Blackbucks, farmers have become hostile to the concept of bustard conservation. In order to get their co-operation eco-development works should be taken up inside the sanctuary area. The various eco-development works suggested to be taken up are establishment of gobar gas plants, cattle breed improvement and stall feeding, lift irrigation and introducing crop insurance scheme with forest department contributing the part of premium as a good will gesture. The compensation of damage to the crop may be made to the owner after making survey of the damage by insurance company team. At present, no such scheme exists with any of the insurance company and such a scheme has to be newly introduced.

Discussion

Alarming increase in the number of Blackbucks in Bustard Sanctuary Karera has become a problem not only for farmers but also for bustard management. Tackling the problem of Blackbucks will be beneficial to the farmers as well as for bustard management. Translocation of Blackbucks to some other suitable area is impossible. All the available method to catch Blackbucks for their translocation have been tried but no success achieved. Its legal status imposes a severe restriction on an effective control strategy such as culling (Chouhan and Sawarkar, 1989). It is suggested that bringing Blackbucks inside enclosures, providing relief measures by growing *Cicer arietinum* for use by Blackbucks, growing of *Zizyphus*

rotundifolia for its maintenance and carrying out eco-development work will be helpful in mitigating the problem. The measures suggested to mitigate the problem of Blackbucks will also be beneficial in bustard conservation.

SUMMARY

Bustard Sanctuary, Karera has over-abundant population of Blackbuck as its main beneficiary. As per 1993 census, estimated population of Black-buck is 3,777. As cultivated fields are frequently invaded by Blackbuck, the problem of crop raiding by Blackbucks has become acute. Blackbucks are also creating problems for Bustard management. This paper presents translocation trails which have been conducted so for, relief measures provided to farmers and suggests measures to tackle the problem of Blackbucks in the present circumstances.

सांरग अभयारण्य, करेरा में कृष्णसार की समस्या सुलझाना

आर०डी० शर्मा

सारांश

सारंग अभयारणय, करेरा में इससे मुख्या लाभ उठाने वालों के रूप में कृष्णसार की अत्यधिक संख्या मिलती है । 1993 की गणना के अनुसार कृष्णसार की अनुमानित संख्या 3777 है । ये कृष्णसार खेतों पर बार- बार धावा मारते हैं इसलिए कृष्णसार द्वारा समस्या फसल उजाड़ने की समस्या विकट बन चली है । कृष्णसार सारंग प्रबन्ध करने में भी समस्यायें खड़ी कर रहे हैं । प्रस्तुत अभिपत्र में अब तक किए गये स्थानान्तरण परीक्षणों, किसानों को राहत पहुंचाने के उपायों तथा वर्तमान परिस्थितियों में कृष्णसार समस्या सुलझाने के उपायों के सुझावों को दिया गया है ।

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CHEMICAL CAPTURE OF A PROBLEM - ELEPHANT IN BOLANGIR, ORISSA

L.A.K. SINGH*, B.N. NAYAK** AND S.K. ACHARJYA***

Introduction

From the year 1977 an Elephant was entering villages, damaging houses and devouring stored food grains from houses in Bolangir and Padampur area of North-West Orissa. Some human casualties and injuries had also occurred.

Staff and experienced labourers were regularly deputed from Simlipal Tiger Reserve to Bolangir and Padampur area and attempts were made every year to drive away the Elephant from area where it was causing damages. In 1988 an attempt was made to apply tranquilisation techniques. None of these attempts resulted in any permanent solution to the recurring annual problem.

Although the people of Bolangir had been complaining about the Elephant every year, in June-July 1995 they agitated went on hunger strike, gheraoed the Divisional Forest Office and created pandemonium in the State Legislative Assembly. They wanted a permanent solution to the problem either by liquidating the Elephant after declaring it as "rogue" or by shifting it elsewhere after reapplying a well planned technique of tranquilisation. Since opinion were divided over its declaration as a rogue, the Chief Wildlife Warden, Orissa decided for the latter.

The success of capture was mainly because of very meticulous planning and preparations. An account of the method and drugs used and the actions taken for post-capture care and attendance is provided below.

Materials and Methods

The teams : A contingent of nearly 45 individuals was involved in the operation. They were from the Departments of Forest, Veterinary, Medical and Police. Two villagers, two important publics and about 8 labourers also participated.

The group was divided into three teams. The first included two trackers and Forest Guard. They were latter joined with the second tram which included the darters, the medical officer and SKA with a loaded pistol to cause blank fire in self defence should an occasion arise. The third team included all the rest members for restraint and post darting veterinary or otherwise care.

The darting equipment : The equipments which were used to dart the animal included the following (a) Dist-inject gun (1); (b) Dist-inject pistol (1); (c) 18-30 m range cartridge to fire the dart from pistol; (d) 30-60m range cartridge for the gun; (e) 5 ml aluminum dart syringe; (f) cartridge for use in 5 ml

* Research Officer, Simlipal Tiger Reserve, Baripada (Orissa).
** Wildlife Warden, Sambalpur Wildlife Division, Sambalpur (Orissa).
*** Divisional Forest Officer, Bolangir (Orissa).

syringe; (g) 35 mm barbed needle, and other darting accessories.

The drugs :
(i) For tranquilisation : 3 doses of 'Immobilon' of 5ml each containing :
Etorphine hydrochloride : 3 mg
Acepromazine maleate : 10 mg

Since entire quantity of the first and third dosages had not penetrated the body and oozing out of the drug at hit points were clearly seen, the total quantity of drug which entered the body was estimated to be about 8.0 mg Etorphine hydrochloride.

(ii) *For revival* :
2 IM doses and 3 IV doses of 'Revivon' containing :
Diprenorphine Hydrochloride : 8.25 mg in total.

(iii) *Human antidote* : The antidote for 'immobilon' in 'Narcan'. A dose of 2 ml Narcan was kept ready at all times with the medical officer who accompanied the darting teams. Each ml of the antidote contained Naloxone HCl 0.4 mg. However, its administration was not required.

The Communication System : Wireless communication network was established among the darting team, the veterinary team, two vehicles parked on the roadside from where we entered the forest, and the headquarter of the Divisional Forest Office. Later a temporary field VHF station was also established at the site where the Elephant was kept after capture.

The teams on foot had tow portophones (Walkie-talkies) and the vehicles had mobilephones. The Division headquarters and the field station operated two large sets as controls.

The Operation strategy :
(i) *Links with villagers and trekking* : Close links were maintained by the staff with local villagers. This was done by visiting the affected area and offering the people advice and devices to scare away the Elephants. Torches (mashals) were provided in the villages and night patrolling by staff was arranged. This generated considerable cooperation and participation from the villagers in tracking the Elephant and reporting its location to the staff.

Other than the staff of the department. Shri Girish Ch. Singhdeo, an advocate of Bolangir, through an organisational capability at village levels brought to us at right times the correct news about location of the Elephant. Most important of such information was about the location in the morning of 25.7.95, the day of capture.

(ii) *Requisites, jobs and movements* : On dt. 22.7.95 minute planning of requisites and work assignment were also chalked out in two sessions under the direct supervision of Shri S.R. Sagar, the Conservator of Forests, Koraput Circle. On 24.7.95 the movement strategy was drawn up and finalised.

On 25.7.95 at 0900 hrs a briefing session was organised for all members including the CDVO, his team and the Medical Officer. This was done with a purpose to acquaint everybody with the technique to be used and the role each member had to play.

After ascertaining the approximate location of the Elephant, on 25.7.95 at 1130 hrs we moved to the field and reassembled before entering the forest. The members were rebriefed about their role.

At first, team 1 moved out to locate the Elephant. The darting team followed the

first within 30 m. The team for post-capture care remained about 200 m behind the second team. After the Elephant was located the first two teams joined-up and the third was asked over the VHF to 'remain open in the air' through the mobilophone in a vehicle.

The capture : The trekking group made their first contact with the Elephant at 1315 hrs. Then the darting group moved to the front. Since we were operating from the ground and there were fairly thick thorny bushes rising above our head visibility was not clear. The Elephant moved towards us when the first dose of tranquiliser was darted from the gun 30-40 m away at 1420 hrs. The dart misdirected, hit the right temple. The Elephant continued to charge and move. At 1530 hrs and 2nd dart was fired from the pistol from a little over 20 m away. It hit at the upper trunk. After about 10 minutes the Elephant rested down on his knees and stretched the trunk on ground but very quickly stood up.

At 1617 hrs the 3rd dart was fired from the gun from about 30 m away to hit the right calf. at 1627 hrs the Elephant slept down on the ground on its right side.

The Elephant : The Elephant is male 9.5 ft (290 cm) at shoulder height and about 50-55 years old. There are no tusks but signs of broken point on left tusk was noticed. The right side could not be checked for broken points. However, it is makhna. It has a number of healed-up injuries. One of the scars on the lower abdomen is deep. The Elephant was named Kharsel after the name of the reserved forest from where it was captured.

Post-Immobilisation Care

Since the time the Elephant was immobilised the CDVO and his team constantly monitored the condition of the Elephant and advised about the records of pulse, respiration and temperature. At one time pulse had risen to 72 against the normal 30 and they had wanted the restraint-operation to be completed fast so that revival antidote could be administered.

After immobilisation care was taken to keep the animal cool, with moist gunny bags and water poured over the body from buckets. Care was also taken to apply castor oil at points where chains and ropes were tied. Besides, antiseptic creams were applied to old injuries.

The Elephant was kept restrained with iron chains and ropes tied between legs and to distant trees. Large crow-bars were also hammered to the ground and offered additional anchor to the ropes. Care was also taken to allow air upto the Elephant, and keep the noise at the minimum.

Antidote Administration

Between 1725 and 1815 hrs the antidote was administered in small quantities of two IM doses and two IV doses of 'Revivon' containing a total of 8.25 mg Diprenorphine Hydrochloride. Each dose was timed and calculated after careful assessment of the physiological data recorded by the CDVO and his team.

Recovery

Signs of recovery were assured when relaxed genitalia completely restored back without any sign of paraphimosis. The genitalia had relaxed to an extruded state within 30 minutes after the third dart hit the Elephant. It retracted back at 1915 hrs i.e. after about two and a half hours from relaxation.

After about nine hours from darting, the sedative effect of Acepromazine was still wearing out and at 2330 hrs on 25.7.95 the Elephant returned to a subconscious state. After that he did not allow recording of pulse through it was still lying down on the ground and deeply snoring.

After nearly twelve hours from immobilisation on 26.7.95 at 0430 hrs. Kharsel lifted his head and attempted to get up, but could not do it because of physical restraint. After a long period of observation at 1330 hrs the cross-chain between the front and hind legs was freed and hind chain was loosened. At 1520 hrs Kharsel stood up and soon afterwards he accepted water to drink and leafy branches of banyan and bamboo to feed upon. He also accepted trunks of banana plants.

Discussion

Traditionally, Bolangir did not have natural Elephants which is linked to scarcity of water. However, in 1929-30 people of Bolangir had seen an Elephant which came from Kalahandi side. A kheda operation was organised by the then Maharaja (father of former Chief Minister, Late Rajendra Narayan Singhdeo). The Elephant died near Titilagarh.

It is said that Kharsel and another female Elephant were with two mahouts. The mohouts were apprehended to police custody in connection with some crime. From that time Elephants remained deserted. It happed in 1976-77. Local people believe that the female had been accepted into some wild population. But two years back people had seen with 'Kharsel' a female Elephant which they thought to be his old mate.

Every year 'Kharsel' followed a definite route of movement. He crosses the Tel river around 3rd week of June and enters Bolangir Division near Kumbharmunda. During July-August he remain near about Bolangir adjoining Reserved Forests like Matkhai, Bonda and Kharsel. Then he progresses North-West towards Budharaja R.F. and enters Padampur. During December he follows the route on return into forest of the Districts Boudh and Phulbani forests.

In his sojourn of 1995, until 22nd July the damages caused by Kharsel included the following: thatched houses - 50, paddy - 30 bags, green gram - 10 kg, rice - 5 bags, sugarcane over 2 dec area, grocery shop - 1, refined oil - 16 liters, k. oil - 16 liters, banana plants - 32 nos., coconut trees - 3, papaya trees - a few, human injuries - 4 cases (in villages Baidupalli, Khalikani and Gandhreil).

Because of the capture an 18-years old problem was solved but it was realised it was not proper to use darts from the ground. Pet Elephants have to be trained for such darting operation and commissioned for use. The entire operation was done under inhospitable conditions and with tremendous risk to lives.

The operation highlights the following points which are of management interest :

- Genesis of a 'problem Elephant' is due to human mistakes. When the mahouts were taken to jail, no one thought of the Elephants which were under the care and direction of the mahouts.
- Female Elephants may get accepted by a wild herd.
- The route which the Elephant followed every year was apparently the route along which he was taken by his mahout.
- Using a dart from the ground is risky as well as not very efficient.

Data Sheet for Recording and Monitoring Immobilised Elephant

Species : *Elephas maximas* Date : 25.7.95
Captive or wild : Ferral
Purpose of capture : Control problem animal/translocate for departmental use.
In herd or alone : Lone
Ambient temperature : 38ºC Day : Bright
Physical condition : Appeared normal, agile.
Emotional state : (before darting) appeared normal.
Name of the drug(s) used:
Drug(s) : Large Animal Immobilon (see text)

Time of injection :	1420 hrs	1530 hrs	1617 hrs
Mg. used	3.5	3.5	3.5
cc. used	drug : 3.5 dist. water 1.5	drug: 3.5 dist. water 1.5	drug :3.5 dist. water 1.5
Route : subcutaneous	i/m	i/m	
Site : rt. temple	Upper trunk	rt.calf	

Remark : loss due to oozing out from point of hit(?)

Behaviour at the time of darting :	Mock-charge	Standing	Turning back
Time when animal goes down (induction time)		(1540 rested for a while)	1627hrs

Sex : male *Breeding status* : Makhna adult
Age 50-55 yrs. *Weight (if possible)* : 3500 kg
Condition of animal (coat, ecto-parasite)
Shining coat, no ectoparasite, with a number of healed-up injuries

Vital signs

Time	T.F	Respiration	Pulse	Revivon inj./signs.
1600	98.4	6	72	
1647	—	-	- -	Genitalia: total relax
1725	—	-	—	1.50 ml IM
1730	98.4	3	34	
1745	98.6	4	36	0.25 ml IM
1750	—	-	—	0.50 ml IV
1815	98	6	24	0.50 ml IV
1830	98	6	36	
1845	98	6	32	Gas release (1st)
1900	—	-	—	Urination
1915	—	-	—	Genitalia: total retract
1930	98	6	36	
2330	98	4		Animal resisted.

Others
Convulsion (none, moderate, extreme) : none noticed
Salivation (none, moderate, extreme) : moderate
Antibiotics Furaxone oint. applied to old injuries
Reversal Name of the drug Large animal revivon (see text)
Time when animal recovered : 0400hrs/26.7.95
Any other comment : Because of physical restraint it was unable to stand up. After restraints were partially removed. it stood up at 152hrs/26.7.95.

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SUMMARY

The paper presents the results of operations launched to capture the Elephant using chemicals in Bolangir.

बोलांगीर, उड़ीसा में हाथी - रसायनिक बन्दी एक समस्या

एल०ए०के० सिंह, बी०एन० नायक व एस०के० अचरजिया

सारांश

बोलांगीर में रसायनिक प्रयोग द्वारा हाथी को पकड़ने की क्रिया का विवरण व प्रमाण इस अभिपत्र में प्रस्तुत किये गये हैं ।

SOME OBSERVATIONS ON AVIFAUNA WITH RESPECT TO HABITAT IN UDAIPUR DISTRICT, RAJASTHAN

ARIJIT BANERJEE*

Introduction

The district of Udaipur lies in South Rajasthan. With a geographical area of 17,64,200 ha, Udaipur lies entirely in the Aravali Range - one of the oldest geological formations on this planet. The terrain varies from flat to undulating to precipitous slopes. Mean rainfall is approximately 600 mm. Summers are long, hot with temperature shooting up as high as 45°C. Winters are relatively short with temperature falling to 2°C. Rains are due to South-West monsoon distributed over the period June to September with a few light premonsoon showers. Other than the dry period of December to May, climate is as such bracing. The many lakes in the region provide a moderating effect on the climate.

Forests

The forests of Udaipur are principally Tropical Dry Deciduous. In the North-West and South-East lie poor site quality Teak (*Tectona grandis*) forests with *Boswellia serrata* as the principal associate. In the rest of the area *Butea monosperma* forests form a biotic climax while dry *Euphorbia* scrub is a climatic climax. Other predominant species in the area include *Dendrocalamus strictus*, *Dalbergia paniculata*, *Dalbergia sissoo*, *Azadirachta indica*, *Madhuca latifolia*, *Lannea coromandelica* etc. Most of the hills as of today due to severe biotic pressure are degraded or barren and are rolling annual grasslands.

Habitats

From an avifaunal perspective, habitats in the region that can be recognised broadly are :

Dry deciduous woodlands. Due to biotic pressure, these are 'habitat islands'.
- Grassland
- Scrubland
- Water bodies, including lakes, anicuts streams, etc.

What determines habitat selection ?

Their volant nature gives birds supreme mobility and makes them far more equipped for habitat selection as per their specific needs than any other animal taxon, distinguished between proximate and ultimate factors involved in this choice of habitat. The phylogeny of habitat preferences on one hand determines and on other is determined by a birds' somatic structure, ethology and its ability to be naturally selected. Proximate stimuli may be landscape, foraging, nesting etc. opportunities, presence of predators or competitors or any other such factors. These factors may occur sequentially or as a synergistic complex.

Selection of a habitat varies in relative importance with residents and migrants. The choice of habitat affects the chances of survival and reproduction and is a result of natural selection.

* Deputy Conservator of Forests, Kota (Rajasthan).

Some examples : In the Udaipur region four species of Kingfishers are observed. The lesser Pied Kingfisher *(Ceryle rudis)* is seen exclusively around the lakes of Udaipur - where the water is still. The small Blue Kingfisher *(Alcedo atthis)* is seen fishing near stagnant and rocky pools during monsoons. The White Breasted Kingfisher *(Halycon smyrnensis)* appears to be a more adaptable species as it rarely chooses between lakes and streams. While the three above mentioned species are fairly common in open areas the Stork Billed Kingfisher *(Perargopsis capensis)* is a local winter migrant which prefers woody areas.

Habitat selection with respect to a Dynamic habitat

Plantation forestry in Udaipur is not very old and 30 year old plantations are the oldest ones standing. The existing natural forest have been continuously felled and lopped and today the erstwhile 'dense' forests have been replaced by grasslands of 'Savannah' type, scrub or barren rock. Since the mid 1980s plantation forestry having taken primary importance, so called 'forest' are emerging often due effective closure. So the available habitat of the area can be called 'Dynamic' in the sense that woodlands have given way to scrub, grassland and barren rock which again slowly are being reverted to optimally stocked high forests. Thus a gradient of habitat preferences can be observed specially with reference to species diversity. A typical example of this is the Red Whiskered Bulbul *(Pycnonotus jacosus)* which was once common here, is still found in the South-East of Udaipur but being a more woodland species is rarely seen in Udaipur today. The more adaptable Red Vented Bulbul *(Pycnonotus cafer)* is ubiquitous.

Species diversity with respect to habitat

Structural aspects of habitats can be used to predict diversity. These are correlated to the features of the habitat which birds use. In this context the concept of *Alpha* (α) and *Beta* (β) diversities need to be explained.

Alpha (α) *Diversity* : This is the number of species that pack into an habitat. This bears a direct correlation to structural and resource diversity.

Beta (β) *Diversity* : This is the rate at which species composition changes with changing habitat types.

The Aravallis in Udaipur are characterised by high Beta diversity as of now as newly emergent grasslands invite species which are different from woodland species. The Paradise Flycatcher - *(Tersiphone paradisi)* is a typical woodland species and is a rare sight with the rapid shrinkage of woodland. On the other hand the White Spotted Fantail Flycatcher *(Rhipidus albicollis abogularis)* being a shrub land species is more commonly sighted.

Munias seemingly exemplify recent range changes. The Green Munia *(Estrilda formosa)* and the White Throated Munia *(Lonchura asiatica)* are common inhabitants of Maize and Sugarcane fields. Increase in cultivation of tall grasses seems to have allowed range extension of the White Backed Munia *(Lonchura strata)* from Central M.P. and or, or Gujarat. The Indian Spotted Munia *(Lonchura punctulata)* is less commonly sighted and the Red Avadavat *(Estrilda amandava)* which is common in

North-western parts of the Aravallis, is still not frequent in sightings in the Udaipur region.

As of today, typically woodland species are confined to the patches of natural forests left and to the middle aged plantations. Raptors, by their local distribution provide some illustrations of habitat preferences. Roosting or hovering Black Winged Kites *(Elanus caerulus)* are common in the grasslands. The Honey Buzzard *(Pernis ptilorhynchus)* - a local migrant is a woodland species and the Shikra *(Accipiter badus)* prefers Scrubland. Their relative sightings vary according to their habitat preferences and the availability of the same habitat.

Choice and use of habitat with respect to sex

It has been observed that in general, while males select only habitats, females select mates, habitats or both. This is somewhat reflected in the nesting behaviour of Weaver birds. The Baya *(Ploceus phillipinus)*, and the Indian Streaked Weaver Bird *(Ploceus manyars)* differ in their choice of nesting sites. The males need yellow flowers as decoration-cum-display-but the degree of their somatic pigmentation determines their needs. Their seems to be correlation in the relative choice of nesting sites in the two species but to draw positive conclusions, detailed studies are necessary. In either species it is the male that builds the nest. The latter prefers tall grasses as nest sites while the former prefers open tree country - Acacias and Palms.

Habitat structure and productivity

Bird species composition changes with habitat structure. Succession illustrates this typically. Both species-diversity and bird-diversity increase with seral stages. The retrogressive succession seen in Udaipur region from high forest to savannah, does induca a change in species but to say empirically that diversity and density decrease would perhaps be wrong without conducting an indepth study. Productivity does affect habitat selection. The sacred groves in Udaipur region are characterised by mature fruit yielding species like *Ficus bengalensis, Ficus religiosa, Madhuca indica* etc. This is where frugivores like Grey Hornbills *(Tockus birostis)*, Koel *(Eudynamys scolopacea)* are common. So is the Large Green Barbet *(Megalaima zeylanica)* and the Coppersmith *(Megalaima haemacephala)*. In open rangeland, seedeaters like Munias, Bayas, Sparrows are predominant. The easy visibility and variety of prey allows a large variety of Raptors and Shrikes in these areas. Camouflage facilities and ample foraging facilities allow Partridges and Quails to occupy scrub and grassland habitat.

In this context it would be worthwhile to take the illustration of the Purple Sunbird - *Nectarina asiatica* - it is typically prominent in spring when most forest species like *Butea monosperma, Erythrina indica, Cassia fistula* etc are in flower. Its only competitor is perhaps the Indian White Eye *(Zosterops palpebrosa)*. The frequency of sightings of both these species decreases with the end of flowering of the above mentioned species proving that productivity and habitat occupancies are interlinked.

The Edge effect: Typically, edges or ecotones are areas of higher and varied productivity. Species diversity of such areas is invariably richer. This is where woodland, rangeland and scrubland species mix. It is here where Grey Partridges *(Francolinus pondicerianus)*, Grey Jungle Fowl *(Gallus sonnerati)* and Indian Pea Fowl *(Pavo cristatus)* retreat for additional cover. Typical edge species include Golden Orioles

- *Oriolus oriolus*, Indian Tree Pie *(Dendrocitta vagabunda)*, Coucal *(Centropus sinensis)* etc. In the edge an increase in incidents of nest parasitism and nest predation is also noticed.

Habitat selection and competition

Higher productivity is usually accompanied by higher competition. Competition tends to reduce food availability. This competition may be interspecific or intergeneric. An example of the former is the Brain Fever Bird *(Cuculus varius)* which competes with the Indian Cuckoo *(Cuculus micropterus)*, pushing the former into a more foliar habitat. Same is the case with the aggressive Black Drongo *(Dicrurus adsimilis)* and the White Bellied Drongo *(Dicrurus caerulescens)*.

Waterlands of Udaipur

The lakes of Udaipur along with the many small and large anicuts and reservoirs are excellent habitat for a number and variety of Waterfowl, most of which are migratory. Though differences in habitat preferences are visible, so far as nesting/foraging sites are concerned, the tremendous pressure of hunting, pollution and tourism has reduced the number of migrants over the years. Habitat study of these Waterfowl calls for intensive and species oriented studies. This topic thus has not been dwelt with in this article.

Conclusion

Succession and natural selection go hand in hand. In the Southern Aravallis, through the years there has been a change in habitat conditions and as a resultant, change in species diversity and local behavioural adaptations. Today the rolling hilly pastures serve as a habitat for a variety of rangeland birds. With more and more new, mixed plantations coming up, it will be worthwhile to observe changes in species diversity, behaviour etc along with the change in habitat.

SUMMARY

The Southern Aravallis in terms of bird habitat have over the years been a 'dynamic habitat'. While today rangeland species dominate in numbers, the 'habitat islands' of woodlands prove to be a home for a variety of avifauna. Contrary to the common postulation that with the increase in seral stages, the variety of species increases, despite retrogressive evolution, species variety has not been affected except in composition. The new plantations in Udaipur will prove to be new niches for a variety of woodland species.

जिला उदयपुर, राजस्थान के पक्षियों के प्राकृतावास के विषय में कुछ पर्यवेक्षण

अजीत बनर्जी

सारांश

पक्षि प्राकृतावास की दृष्टि से दक्षिण अरावली प्रदेश विगत वर्षो में गतिशील-प्राकृवास रहा है । यद्यपि आकल घास प्रदेशीय जातियों की सँख्या की दृष्टि से प्राधान्य है, वृक्षवान भूमियों के "प्राकृतावास द्वीप" अब भी कई प्रकार के पक्षियों का घर बने हुए हैं । इस सामान्य सिद्धान्त के प्रतिकूल कि संश्रंणिज अवस्थाएं बढ़ते जाने के साथ पश्चगामी उद्विकास होने पर भी जातियों की किस्में बढ़ती जाती हैं, यहाँ पर उनकी रचना को छोड़कर जातियों की किस्मों पर कोई कुप्रभाव पड़ा नहीं पाया गया । उदयपुर में लगाए जा रहे नए रोपवन वन में मिलने वाली जातियों की कई किस्मों के लिए नए क्षेत्र सिद्ध होगें ।

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OBSERVATIONS ON THE AVIFAUNA OF MOUNT HARRIETT NATIONAL PARK, SOUTH ANDAMAN (A & N ISLANDS)

KAILASH CHANDRA AND P.T. RAJAN

Zoological Survey of India, Port Blair (A & N Islands)

Introduction

Mount Harriett National Park is one of the eight national parks so far declared in the Union Territory of Andaman and Nicobar Islands. The park is situated in South Andaman at 38 km from Port Blair. It lies between 10°43'57" to 11°51'55"N latitudes and 92°43'41" to 92°47'11" E longitudes. The park possesses various hill ranges like Mt. Warden, Mt. Hext, Mt. Koyob, Mt. Goodridge and Mt. Carpenter. The highest peak of Mount Harriett National Park is 450 m above sea level. Area of the park is about 46.62 km^2 with a proposal to extend the area by another 1700 ha to include the adjacent hill ranges. The park is covered with thick green vegetation, comprising of Andaman tropical evergreen, Andaman moist-deciduous and Andaman semi-evergreen forests. On the east coast, the seashore indented and streches from old Madhuban to Baruatong beach. The beaches are mostly rocky and sandy at a few places. The park also possesses few water streams, arising from the Mount Harriett range and draining into the sea on the east coast.

Adequate work has been carried out on avifauna of Andaman and Nicobar Islands by the various workers like Abdulali (1964, 1965, 1967), Ali and Ripley (1968-1974), Dasgupta (1976) and Tikader (1984). But, there is no comprehensive information on the avifauna occurring in this national park. Only few birds were recorded by Abdulali (1965, 1967). Hence, an attempt has been made to give a complete list of birds occurring in the Mount Harriett National Park. The present observation was made during the faunal exploration of National Park form June 1993 to May 1995. In all, 88 species of birds belonging to 68 genera representing 32 families were observed from different localities as mentioned in the list of species (Table 1). We have followed the taxonomic account upto the species level, inspite of prominent variation at sub-species level. We also feel that an intensive survey of the national park is quite to likely reveal the existence of more number of bird species.

While exploring the faunal diversity of Mount Harriett National Park, it was observed that the nearby inhabitants and settlers were entering to the national park for hunting the birds. Birds like Andaman Wood-pigeon, Grey fronted-green pigeon, Green imperial pigeon, Red turtle dove, Emerald dove and White breasted water hen were the main target of poachers. The above mentioned birds are not included in Schedule I of the Wildlife (Protection) Act, 1972, hence, there is no strict legal protection for the conservation of these birds, which warrants immediate attention of the concerned authorities for necessary action in the matter.

Table 1
List of Birds recorded from Mount Harriett National Park

Species	Natural sightings	Occurrence
1	2	3
Ardeola grayii (Sykes)	II, IV	C
Bulbulus ibis (Linnaeus)	II, IV	C
Egretta sacra (Gmelin)	II, IV	C
Ixobrychus sinensis (Gmelin)	II	R
Aviceda leuphotes (Dumont)	III	VR
Accipiter virgatus (Temminck)	I, II, IV	C
Spizaetus cirrhatus (Gmelin)	I, II, III	C
Haliaeetus leucogaster (Gmelin)	I, II, IV	C
Cirrus Macrourus (S.G. Gmelin)	II, IV	C
Spilornis cheela (Latham)	II, III, IV	C
Spilornis elgini (Blyth)	II, IV	C
Rallus canningi (Blyth)	II, IV	C
Amaurornis phoenicurus (Pennant)	I, II, III	C
Gallicrex cinerea (Gmelin)	I, II, III	C
Gallinula chloropus (Linnaeus)	II, IV	C
Dromas ardeola (Paykull)	II, IV	A
Esacus magnirostris (Vieillot)	II, IV	A
Pluvialis dominica (P.L.S. Muller)	II, IV	C
Pluviatis squatarola (Linnaeus)	II, IV	C
Charadrius asiaticus (Pallas)	II	C
Charadrirs dubius (Scopoli)	II, IV	C
Charadrius leschenaulti (Lesson)	II, IV	C
Charadrius mongolus (Pallas)	II, IV	C
Tringa hypoleucos (Linnaeus)	II, IV	C
Tringa totanus (Linnaeus)	II	R
Sterna sumatrana (Raffles)	II, IV	C
Treron pompadora (Gmelin)	I, II, III	A
Ducula aenea (Linnaeus)	I, II, III, IV	A
Columba palumboides (Hume)	I, II, III	A
Macropygia rufipennis (Blyth)	I, II	C
Streptopelia tranquebarica (Hermann)	I, III	C
Chalcophaps indica (Linnaeus)	I, II, III	C
Pasttacula alexandri (Linnaeus)	I, II, III	A
Psittacula eupatria (Linnaeus)	I, III	C
Psittacula longicauda (Boddaert)	I, II, III, IV	A
Loriculus vernalis (Sparrman)	I, II, III	A
Cuculus micropterus (Gould)	I, III, IV	C
Eudynamys scolopacea (Linnaeus)	I, II, III, IV	A
Centropus andamanensis (Beavan)	I, II, III, IV	A
Otus balli (Hume)	I, II	C
Ninox affinis (Beavan)	I, II, III	C

Contd...

1	2	3
Ninox scutulata (Reffles)	I, III	C
Caprimulgus macrurus (Horsfield)	I	R
Collocalia brevirostris (Horsfield)	I, II	C
Collocalia esculenta (Linnaeus)	I, II, III, IV	A
Collocalia fuciphaga (Thunberg)	I, II, IV	A
Chaetura gigantea (Temminck)	I, II, IV	C
Apus apus (Linnaeus)	I, II, IV	C
Alcedo althis (Linnaeus)	II, IV	C
Alcedo meninting (Horsfield)	II, IV	C
Ceyx erithacus (Linnaeus)	I, II, IV	C
Halcyon smyrnensis (Linnaeus)	II, IV	C
Merops leschenaulti (Vieillot)	I, II, IV	C
Merops philippinus (Linnaeus)	I, II, IV	C
Eurystomus orientalis (Linnaeus)	I, III	C
Dryocopus javensis (Horsfield)	I, III	C
Picoides macei (Vieillot)	I, II, III, IV	C
Hirundo tahitca (Gmelin)	I, II	C
Lanius cristatus (Linnaeus)	I, III	C
Oriolus chinensis (Linnaeus)	I, II, III, IV	A
Oriolus xanthornus (Linnaeus)	I, II, III, IV	A
Dicrurus andamanensis (Tytler)	I, II, III	A
Dicrurus paradiseus (Linnaeus)	I, II, III	A
Artamus leucorhychus (Linnaeus)	I, III	C
Sturnus erythropygius (Blyth)	I, III	C
Acridotheres tristis (Linnaeus)	I	C
Gracula religiosa (Linnaeus)	I, II, III	A
Dendrocitta bayleyi (Tytler)	I, II, III	A
Corvus macrorhynchos (Wagler)	I, II, III, IV	A
Coracina nigra (Kloss)	IV	R
Coracina novaechollandiae (Gmelin)	I, III	C
Coracina striata (Boddaert)	I, III	C
Pericrocotus cinnamomeus (Linnaeus)	I, III	C
Pericrocotus flammeus (Forster)	I, II, III	C
Irena puella (Latham)	I, III	C
Pycnonotus atriceps (Temminck)	I, II, IV	A
Pycnonotus jocosus (Linnaeus)	I, II, III	A
Muscicapa latirostris (Raffles)	II, IV	C
Hypothymis azurea (Boddaert)	II, IV	C
Cettia pallidipes (Blanford)	I, II, III	C
Phylloscopus trochiloides (Sundevall)	I, II, III	C
Copsychus malabaricus (Scopoli)	III	R
Copsychus saularis (Linnaeus)	I, II, III, IV	A
Zoothera citrina (Latham)	II, IV	C
Dicaeum concoloor (Jerdon)	I, II, III	C
Nectarinia jugularis (Linnaeus)	I, II, III	A
Zosterops palpebrosa (Temminck)	I, III	A
Emberiza pusilla (Pallas)	I, III	C

I= Mt. Carpenter, II = Madhuban, III = Mt. Hext, IV = Bhoji Nala, A = Abundant, C = Common, R = Rare, VR = Very Rare.

Acknowledgements

The authors are grateful to the Director, Zoological Survey of India, Calcutta and Dr. G.C. Rao, Officer-in-Charge, Zoological Survey of India, Port Blair, for providing necessary facilities and encouragement to carry out this work. Thanks are also due to the party members for their invaluable assistance in the field. The authors also thank Forest Department, Andaman and Nicobar Administration, for their help and support in surveying faunal diversity of the Mount Harriett National Park.

SUMMARY

The present paper reports the occurrence of 88 species of birds from different localities of Mount Harriett National Park, South Andamans.

माऊंट हेरियट राष्ट्रीय उद्यान (अंडमान) के पक्षियों का अवलोकन

कैलाश चन्द्र व पी०टी० राजन

सारांश

प्रस्तुत अभिपत्र में माऊंट हेरियट राष्ट्रीय उद्यान (अंडमान) के विभिन्न आवासों में पाये जाने वाले पक्षियों की प्रजातियों को प्रस्तुत किया गया है ।

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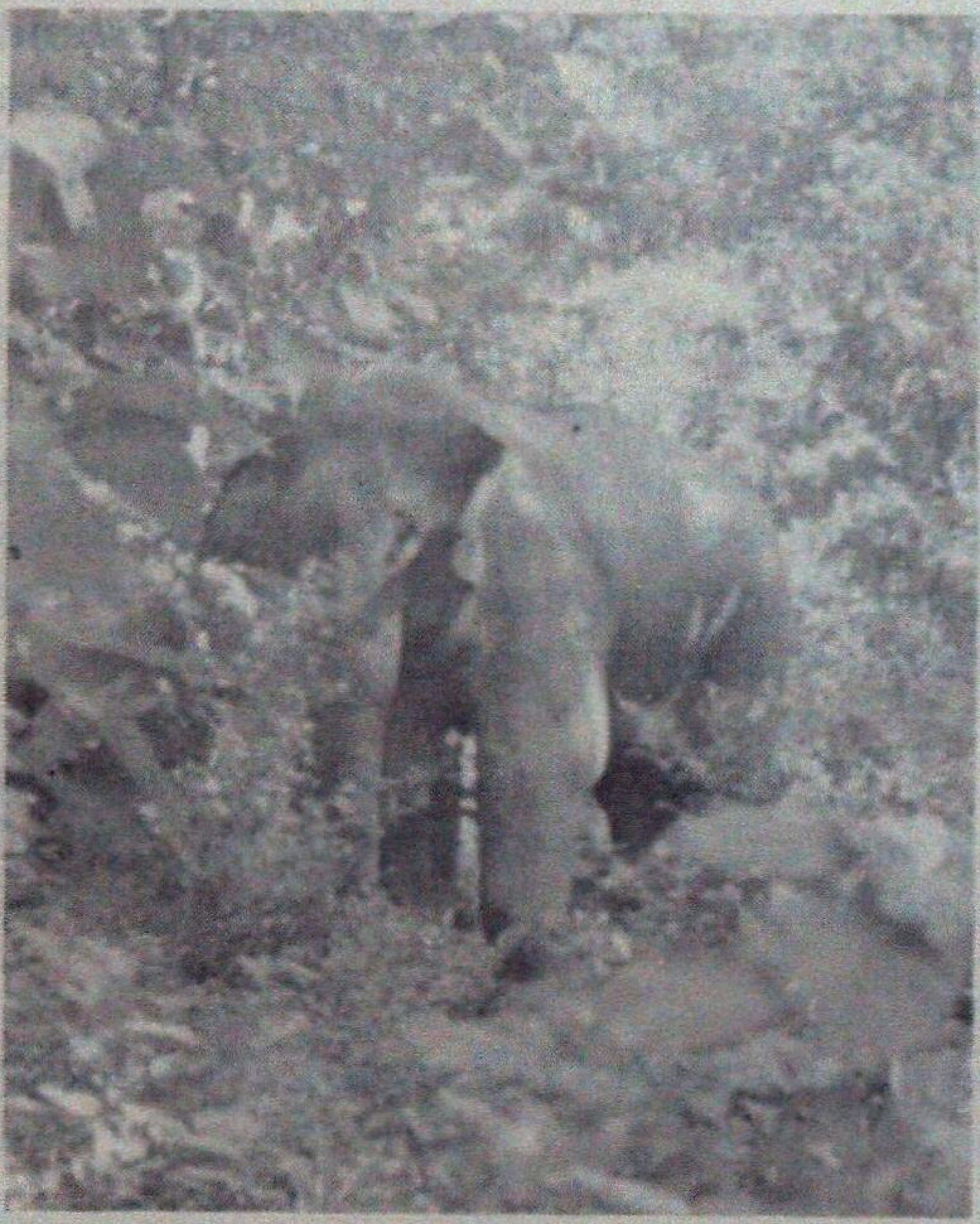
FOREST NOTES AND OBSERVATIONS

TREATMENT OF AN INJURED WILD ELEPHANT IN NORTH BENGAL FORESTS

A solitary male tuskless (Mukna) wild Elephant was sighted by the forest staff in the Panighata Resume land forest in early hours of 6th October 1995. The author visited the area to see the condition of the Elephant. The Elephant had an injury in his left foreleg which had swollen so such that the Elephant was not able to put its weight on it. The animal was literally moving on three legs with great difficulty. It seemed to be in a bad mood and gave a mock charge each time it was approached to get a closer look at the wound. It was decided that the animal required immobilization to carry out the necessary medical treatment of injuries.

Fig. 1



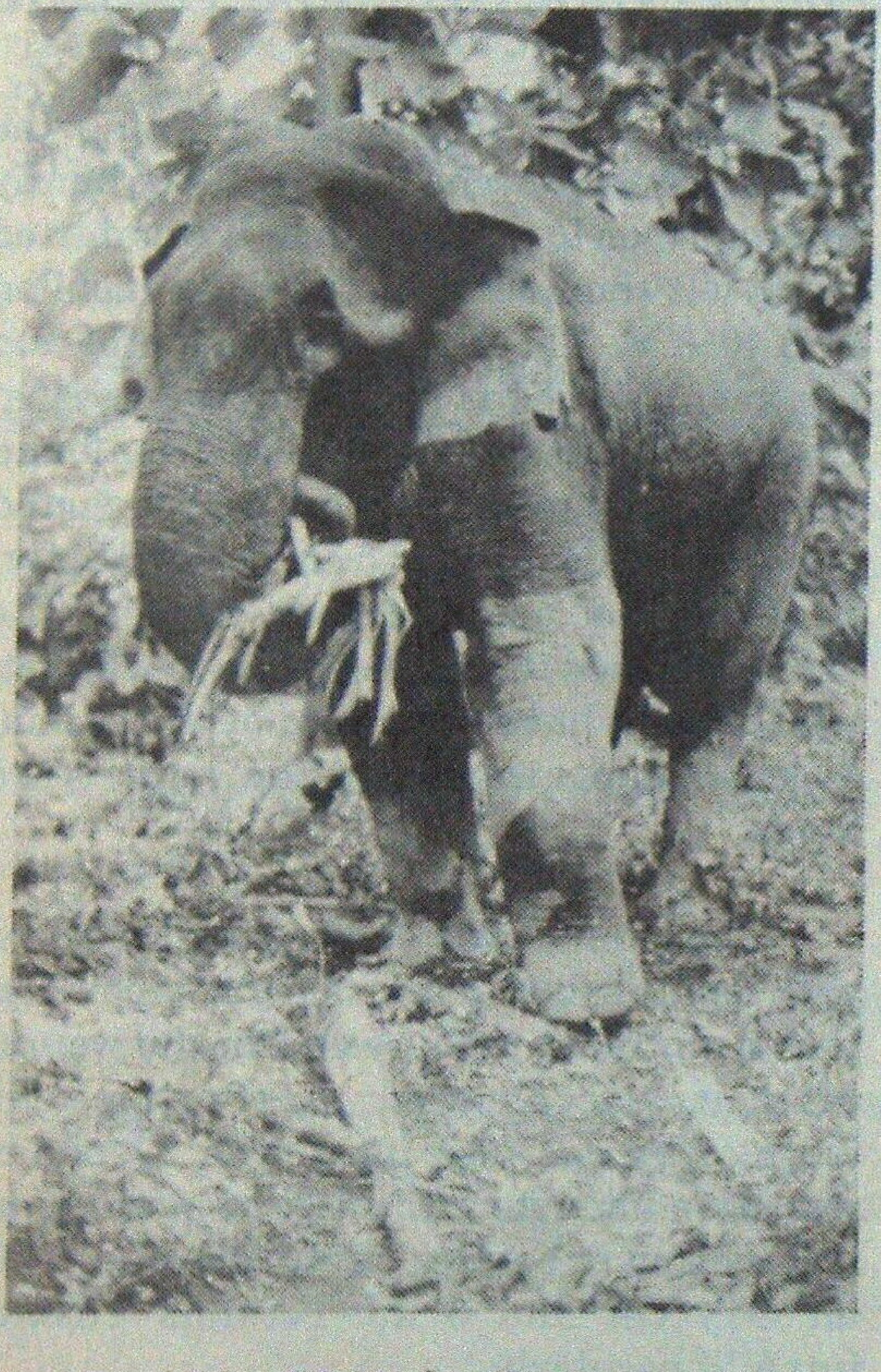
Panighata Elephant before treatment

Next day, early in the morning the animal was approached on foot. It was hardly in a condition to move around. It was darted on its left shoulder with 3.3 ml Immobilon at 8.40 A.M. The Elephant stood still and lay down after eight minutes of the darting. On exA.M.ination of the animal it was found that its left fore knee joint had a wound about 25 cm deep and 2.5 cm in diA.M.eter. It was full of pus and dead tissues. The wound seemed to be caused due to a bullet, which might have been fired at the animal to drive him away from the agriculture fields.

The wound was cleaned and washed with iodine solution and 500 gm of povidon iodine ointment was pressed in the wound after it was cleaned. A fly-repellent (surgicare) was also used. The Elephant was also administered 5 ml Dexa-methazone intravenously besides 12 ml Decadron, 30 ml Oxy-Vet and 5 ml Tetanus Toxoid intrA.M.uscularly.

The entire operation lasted for 54 minutes, after which the Elephant was given 3.3 ml Revivon intramuscularly at 9.42 A.M. There was trunk movement at 9.51 A.M. and ear movement at 9.54 A.M. Tail movement was also noticed at 9.56 A.M. However, the animal did not seem to recover. Therefore, another dose of 1.5 ml Revivon was injected intravenously at 10.10 A.M. There was body movement at 10.15 A.M. and at 10.16 A.M., its left leg went into the air abruptly and came down heavily. Eye lid movement was noticed at 10.30 A.M.

Fig. 2



Panighata Elephant after treatment

Thereafter, there were no signs of recovery for about half an hour. At this point of time, it was noticed that we had used the Revivon, for which the expiry date was already over. A fresh dose of 2.0 ml Revivon from new stock was administered intravenously at 11.30 A.M. and the animal had fully recovered by 11.25 A.M., after two hours and forty five minutes of darting. The body temperature during the entire operation varied between 98 and 99°F. To keep the body temperature normal, water was sprinkled on the animal from time to time during the entire operation. The respiratory rate (per minute) varied between 6 and 7. The pulse rate (per minute) after 40, 110, 120 and 145 minutes of anaesthesia was 62, 52, 41 and 48 respectively.

The Elephant was offered banana culms and bananas and it started eating them at 11.35 A.M., after 10 minutes of full recovery. It was kept under constant watch by the forest staff. It remained at the same spot for about 24 hours moving within a distance of 5 meters. In between, it again ate the banana culms and drank the water. The swelling on its leg was noticed to be reduced to some extent and the animal was looking a bit rejuvenated. It was no more hostile to the forest staff who were around to keep a watch. In fact, it appeared as if the Elephant was trying to show his feeling of gratefulness to them.

Thereafter, the elephant moved out of Panighata Resume land forest to enter Tirihana tea-gardens and it was found in the reserved forest area of Kadama Block under Bagdogra Range after 3 hours, having travelled a distance of at least 8 km.

The Elephant was again sighted after 18 days and it was found to be in a normal condition.

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Divisional Forest Officer,
Wildlife Division - I, Darjeeling (West Bengal)

N. Singhal

LETTER TO THE EDITOR

To
The Hony. Editor,
Indian Forester,
New Forest, Dehra Dun (U.P.)

Sub : **Black Tigers of Similipal Tiger Reserve, Orissa**

Sir,

There appears to be an increase in the sighting of 'Black' Tigers in Similipal. Recently, along the road from Pandabandha to Khadkei chhak in Nawana Range, a 'black' tigress with three cubs were sighted around 1630 to 1700 hrs on 25.4.96 by the antipoaching labourers of Pandabandha. Again, in good sunlight at 1700 hrs on 27.4.96 three black cubs apparently those seen on the 25th, were sighted within a distance of 16m by Shri B.C. Behera (Range Officer, Nawana), Shri Gouranga Naik, FG and Driver Shankar between Bhandadarha chhak and Bhajam. A black coat with yellow stripes were clearly seen as the cubs remained standing on the road for about "3-4 minutes".

Research on 'Black' Tigers gained ground in June 1993 after one such Tiger got killed on dt. 21.7.93 In the previous night the Tigress entered into the cowshed of Surai Besra, 67yrs, of village Podagad on the western periphery of Similipal. On approaching the cowshed, Surai was charged at by the Tigress and got injured. When other members of the family approached the scene the Tigress retreated. The next morning, at about 10 A.M. Salku, Surai's son, sighted the Tigress in the adjoining maize field. The Tigress charged towards Salku who in turn ran into his house and from there aimed at and killed the Tigress with three arrows.

The coat of the Tigress thus killed had a black background with tawny stripes on the back and white ventrally (Prusty, B.C. and L.A.K. Singh, Tiger Paper, in Press, 1994). So, more appropriately this is 'melanistic' and not 'black'.

On dt.16.8.91 at about 1700 hrs Niranjan Mohanta (since deceased), FG had seen a family of four Tigers along Devasthali-Patabil road. The group consisted of two full-grown adults and two cubs one of which appeared to be black.

On dt.01.03.96 Forester Shri B.C. Nayak of Devasthali saw a full grown Black Tiger near Baladaghar at 1700 hrs. The stripes were distinctly yellow.

Again, at about 0800 hrs on dt.03.04.96 a "Black Tiger" was sighted by Shri B.C. Nayak near Bachhurichara, a place between Patabil and Devasthali.

On dt.12.4.96 Shri Lugu Majhi, Forest Guard sighted a full grown Black Tiger with yellow stripes at 1545 hrs between Patabil and Devasthali.

In winter 1975-76 two full grown completely Black Tigers were sighted on the road the leading to Matughar by Shri K.C. Pati (then) Range Officer, Shri B.N. Nayak (then) Asstt. Field Director and two overseas tourists.

These sightings merit discussion about the colour variations in Tiger. Earlier, a Tiger without stripes was reported from Similipal. and a similar information was cited from Chitrakonda of Koraput in Orissa (Sagar, S.R. and L.A.K. Singh (1989) : *Indian Forester*, 115 (4) : 277-278).

The "White Tigers" of Nandankanan which hit the news during 1981 have a white coat with dark brown or reddish-black stripes. The normal tawny base of the coat of the species is also known to show variation in deepness. some Tigers are light-orange-red while others are deep. Such variations are often attributed to geographical regions, the forest-habitat, and perhaps the season, as well. Completely "Black Tigers" are also known in the literature.

With the accumulation of more information on coat-colouration of Tiger the hypothesis (Prusty, B.C.and L.A.K. Singh, *Zoos' Print*, Sept., 1996) is gaining ground that white or Black Tigers are not mutants but the genes for such uncommon colours normally occur in the gene pool of the species in a recessive state. These genes express the characters when there are total or partial but adequate segregation. Such Tigers are not easily detected in nature because these are rarer than the normal Tigers. It is desirable to induct tools like trip-cameras and study such facets of 'tigerology' as colour variations without having to wait for a chance occurrence in captivity or accidental killing and detection in the wild.

Yours Faithfully,

Sd/-
Ch. G.H. Mishra
Principal Chief Conservator of Forest,
Bhubaneswar (Orissa)

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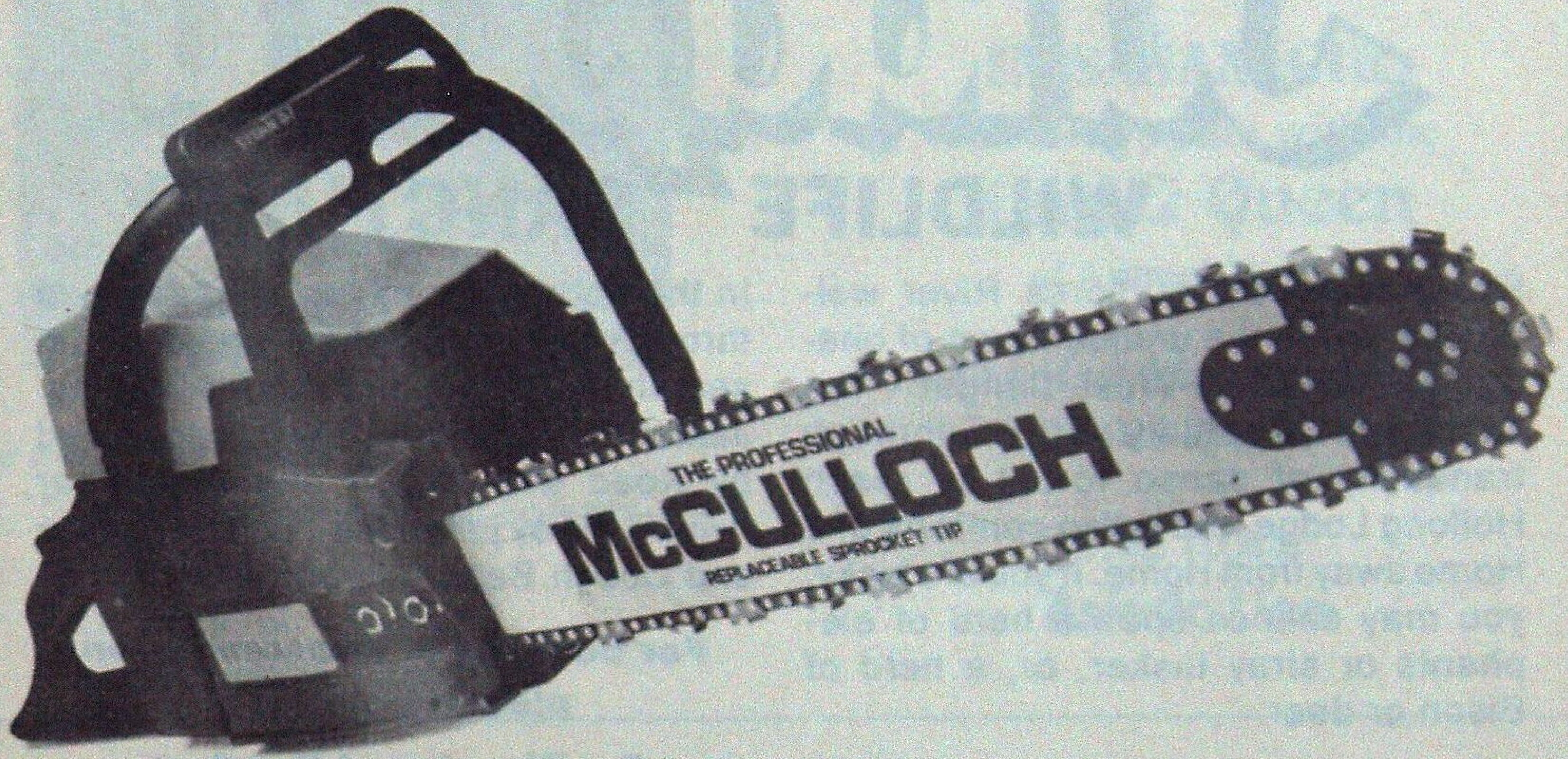

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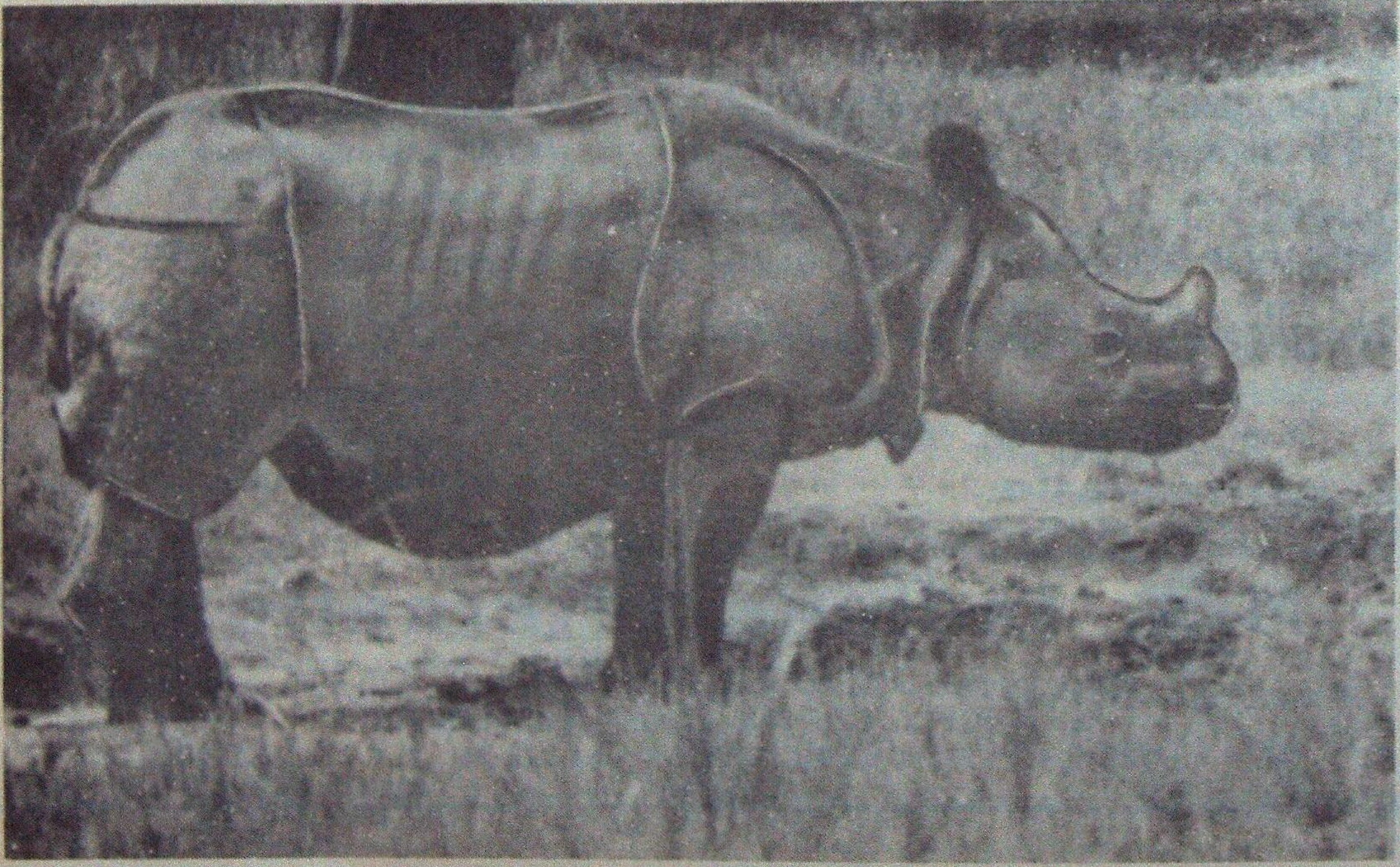

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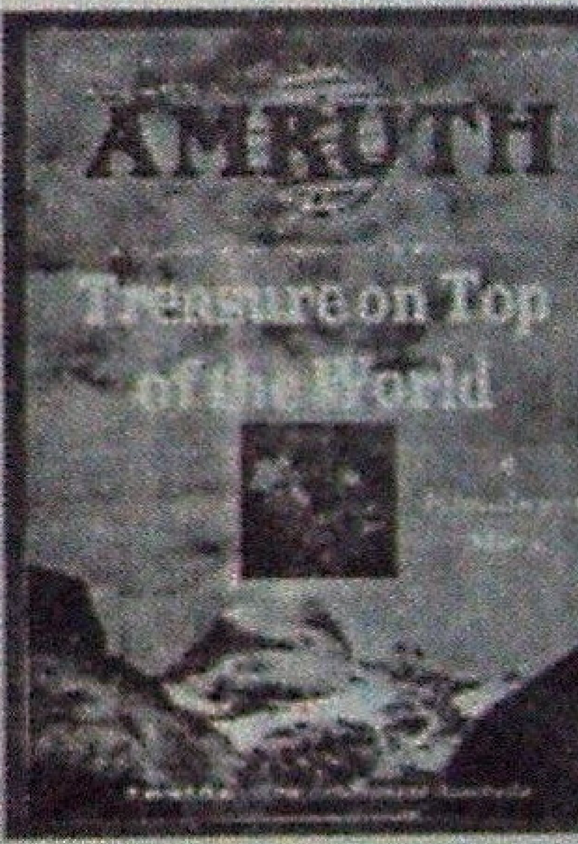

As a support measure, the Foundation has launched a "cultural ambassador" in the form of a magazine to carry its message to as wide a section of the conservation-committed public as possible. AMRUTH, a bi-monthly, gives in-depth analysis of plants, finely-detailed illustrations, feature stories, photo essays and topical medicinal plants-related issues dealing with politics, history and people.

To keep AMRUTH a quality output that can continue disseminating useful information, FRLHT invites subscriptions. We see our subscribers as cultural ambassadors, too; for it is they who will help keep India's medical traditions a dynamic force that can serve future generations.

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Phone No. 2179

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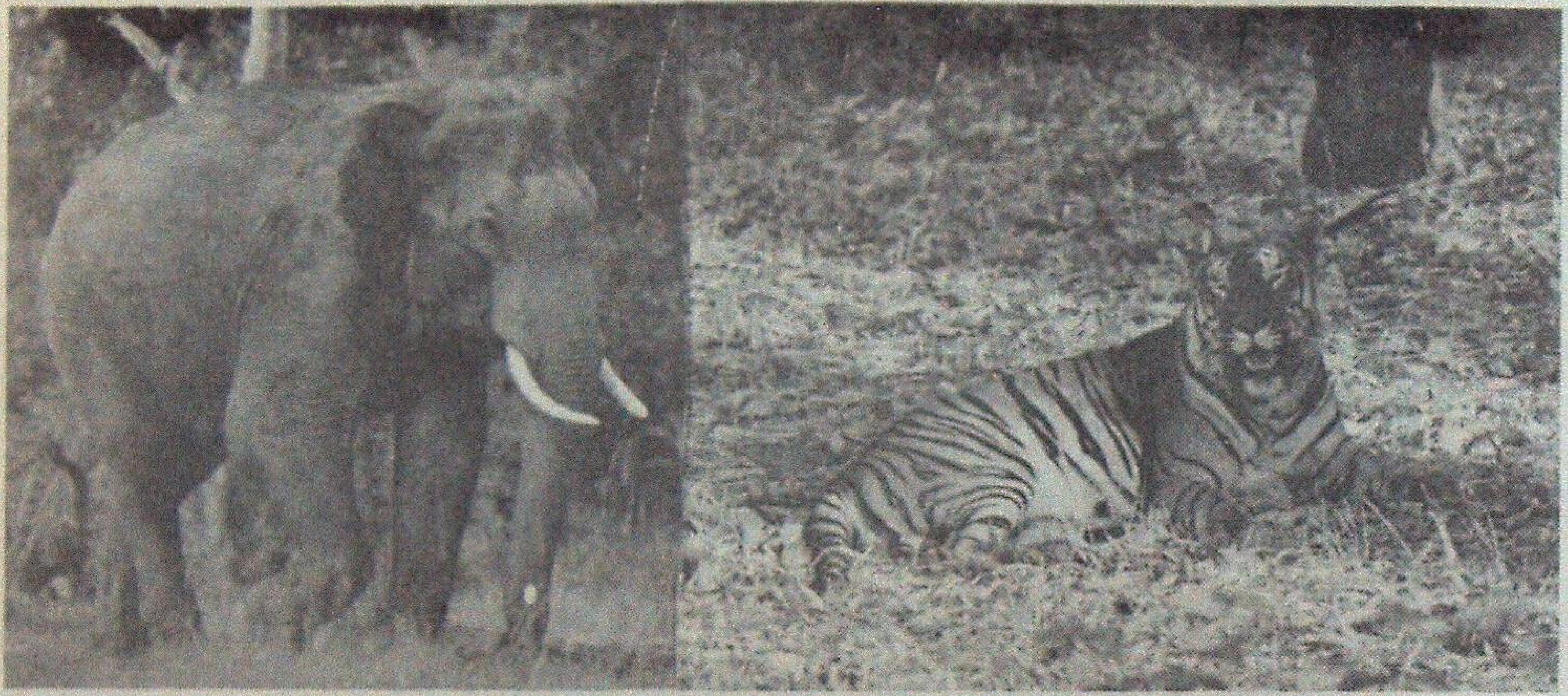

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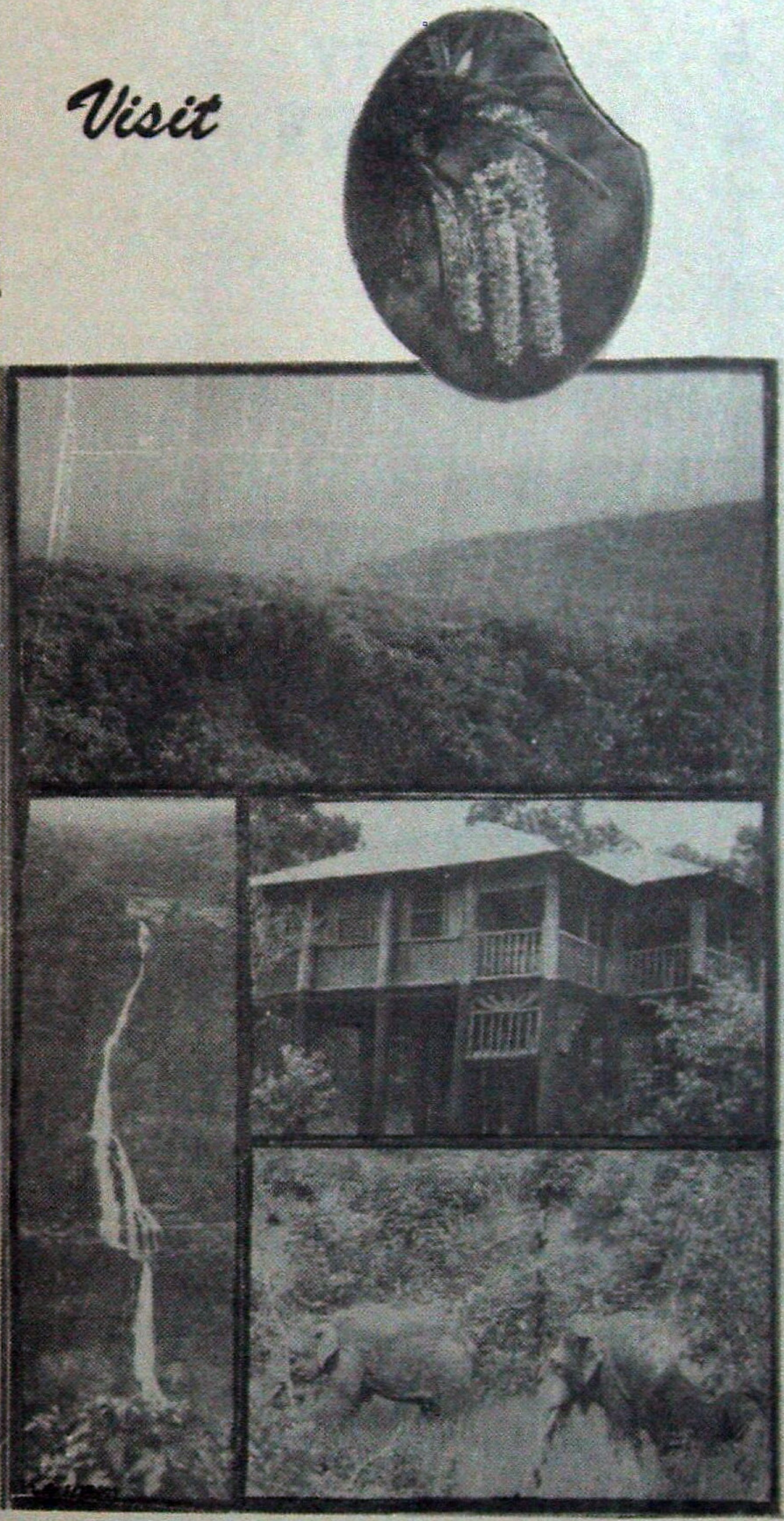

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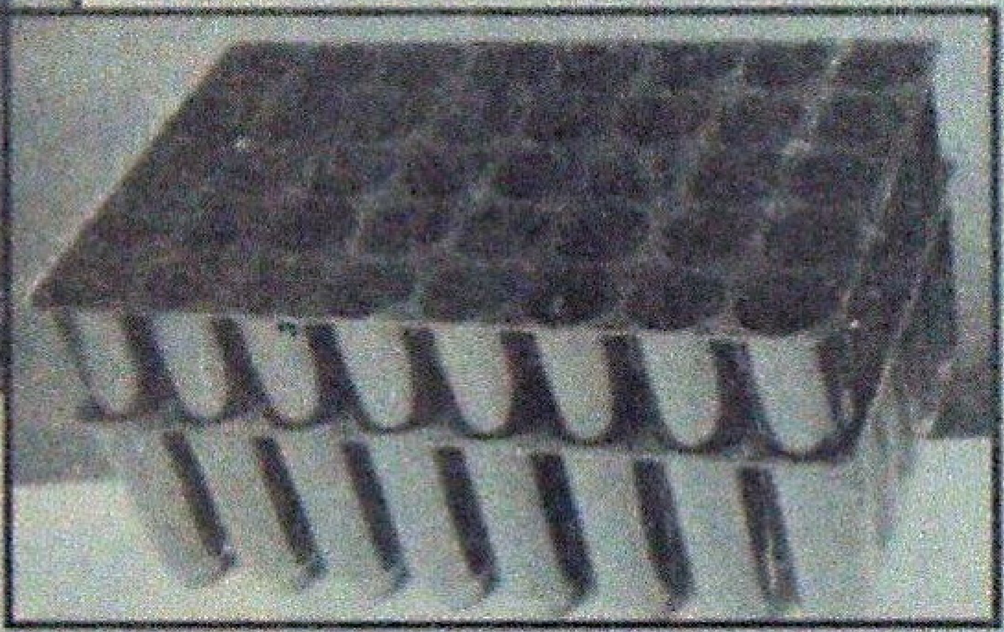

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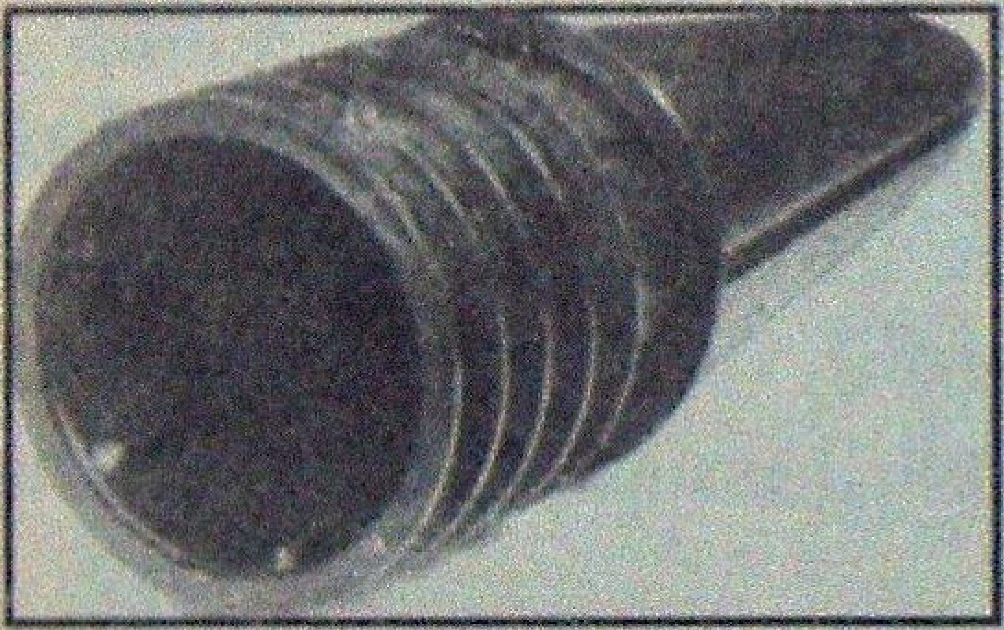

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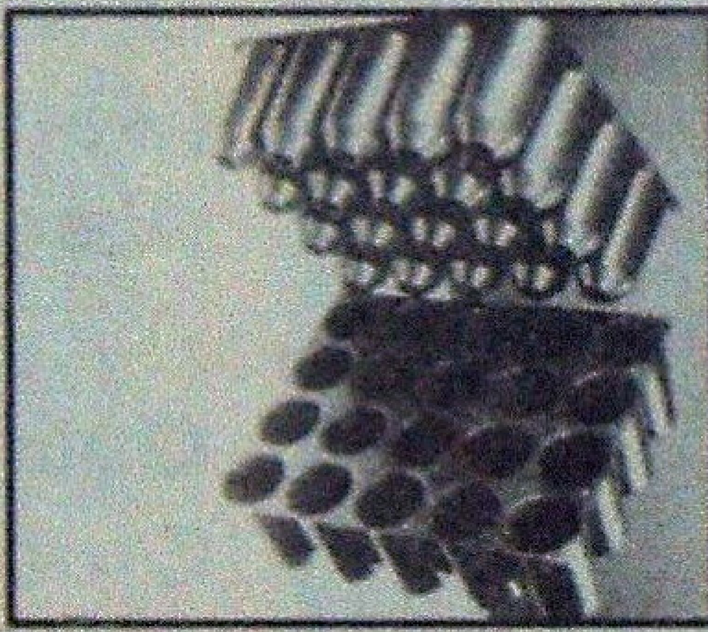

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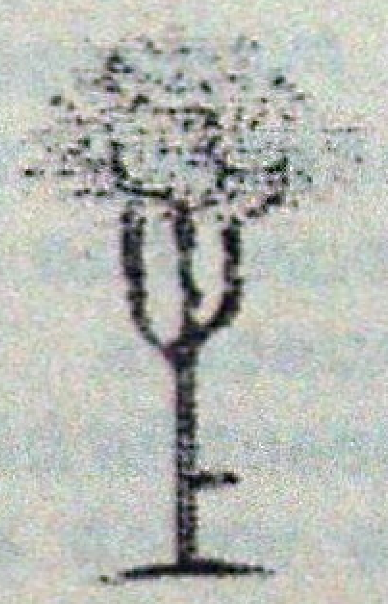

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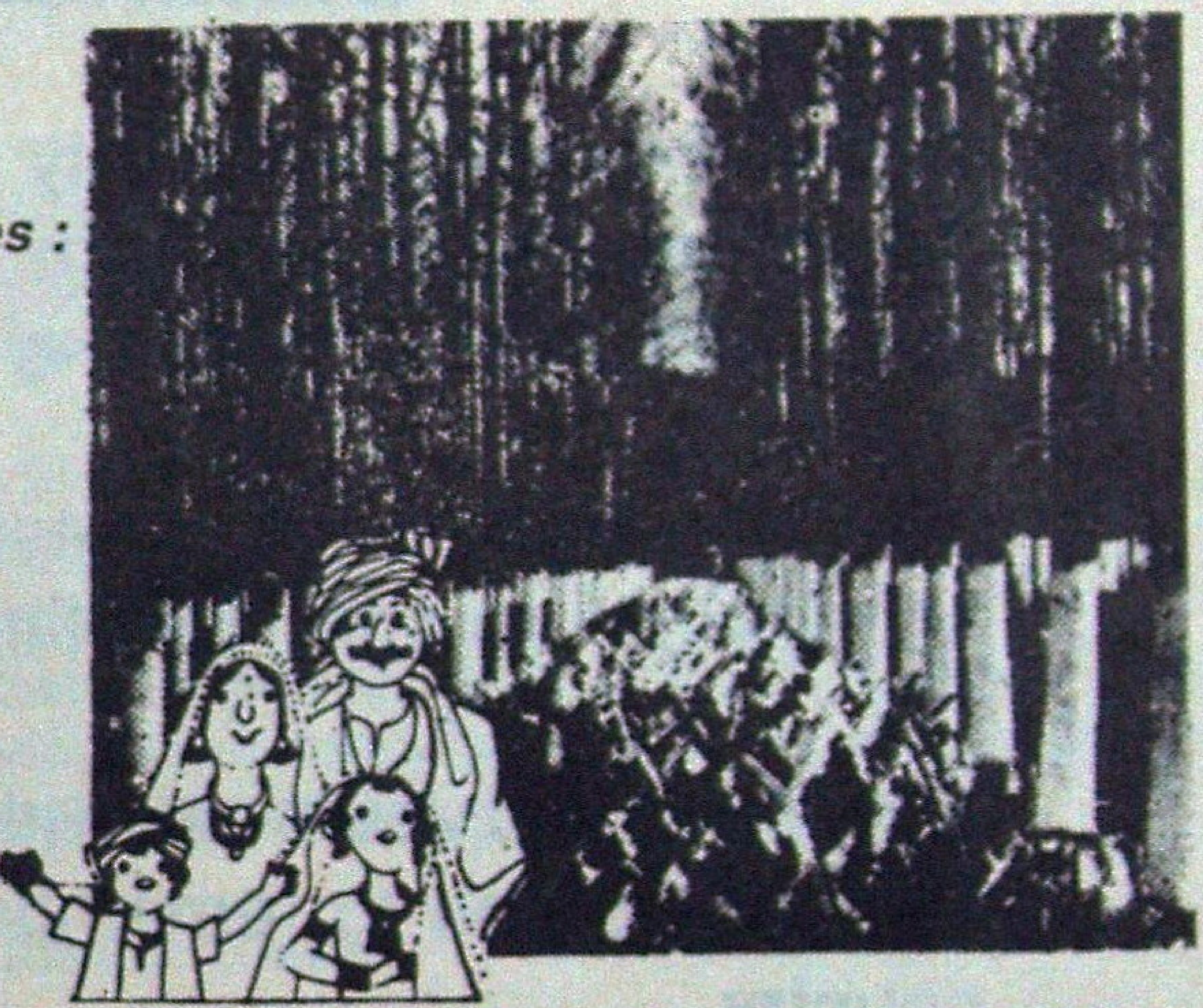

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For further information please contact :

Chief Wildlife Warden,
Environment & Forests Complex,
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Field Director,
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